ESTIMATION OF RENEWABLE ENERGY RESOURCES FOR ESTABLISHMENT OF GREEN MICROGRIDS

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ABSTRACT

The current Indian Power economy poses a great challenge to the dynamics of energy security of the power hungry 21\textsuperscript{st} century. As technology is the roost there is an urgent need to eliminate energy poverty. The major source of power in India is through conventional energy sources like coal, fossil fuels etc. The perishable nature of these primary fuels brings in the need to tap energy from unexplored avenues. Some of the well-known and well established sources such as wind, biomass potentials have already been estimated. However newer sources available whose potential is not estimated. This paper attempts to estimate the potential of such sources like Ocean Thermal Energy Conversion (OTEC), Biomass etc. As technology progresses commercial extraction of this energy can be made possible. The case studies of the states of Andhra Pradesh and Telangana in India has been taken and the current challenges and possible solutions have been presented here. In a nutshell the solution promotes the establishment of renewable micro grids to address local energy needs.

Keywords: Bio-Mass, Micro Grid, OTEC, Renewable Energy, Solar Energy, Wave Energy

I INTRODUCTION

The Indian power economy is characterized by a number of technical and economical challenges where the grid is not extremely reliable. The centralized model of power generation, transmission and distribution is the most challenging issue of energy security where the energy needs of the power hungry 21\textsuperscript{st} century is being addressed by a grid system which is vulnerable to both internal and external, technical and non technical threats. The constantly unequal demand supply energy equation with around 10\textperthousand15\% shortage brings in the need to establish viable power infrastructure. High electricity costs coupled with uncertainty of supply deter the economic and technical progress of the society.

The power blackout in August 2012, cyclones like the Orissa super cyclone of 1999, Tsunami of 2004 and Hudhud of 2014 make us realize the need for power backup during natural disasters at least for critical infrastructure like hospitals, public transport and other institutions like the military. This would help in disaster management as electricity is a fundamental requirement of communication and comfort and also reflects the standard of living.
1.1. Need to transform towards renewable energy

An energy source with lower carbon footprint is a better energy source. Conventional sources of energy emit greenhouse gases both during manufacture of the components and also during running of the plant. For example, a thermal power plant emits greenhouse gas (GHG) during operation due to burning of coal and also during manufacture of components. A solar plant on the other hand has lesser carbon footprint associated with it as GHG emissions during operation are almost negligible in comparison.

The benefits of Renewable energy over conventional energy are [1, 2]

- Perishable nature of raw material viz. Coal.
- Sustainable, relatively clean and efficient
- Non-exhaustible
- Greater scope for decentralization
- Domestic sources and gives greater energy independence
- Price is not very fluctuating as it is dependent on the initial investment cost and running costs mainly consisting of labor and maintenance of the plant. International prices of oil or uranium fuel do not affect it and improved technologies can allow equitable, accessible and efficient energy systems.
- Conventional energy production from fossil fuels and nuclear power requires centralized management and large distribution infrastructures. They are more vulnerable to security threats and the consequences of system breakdowns or disruptions are higher.

1.1.1 Need for establishment of renewable micro grids:

- To implement self-sustenance to address energy demands for critical infrastructure like hospitals and also consumers like educational institutions, railways, public transport [3].
- Perishable nature of fossil fuel power dependence
- Reduce global warming and greenhouse gas production
- Reliable, sustainable and clean energy
- Address peak load demand in summer by solar power systems.
- Implement community owned micro grids and increase awareness on collective responsibility to ensure greater public participation.

II CURRENT ENERGY SCENARIO IN ANDHRA PRADESH AND TELANGANA, INDIA

The installed and generation capacities have grown in the erstwhile united Andhra Pradesh (AP) in the last decade. With more upcoming projects higher generation capacity will be installed. However the demand has always outstripped supply due to non-utilization of the complete installed capacity. The erstwhile united Andhra Pradesh Generation Corporation (APGENCO) which produced more than half of the state’s power is the third highest power utility with the second highest hydro energy harnessment. However a considerable portion of its power comes from the technically old pulverized coal cycle (PCC) thermal power plants. The installed renewable capacity in AP and TS is 1112MW which is about 4% of the country’s installed 28000MW [8].
The details of power by various power houses in AP and Telangana state[TS], India and the power shared by AP and TS with Central sector projects of India are presented in the table- I to table- VIII [4]. The details are provisional and the installed capacity indicated in the tables is as on 31.08.2013.

With the recent bifurcation it has become crucial that a quick solution be obtained to address local energy needs in Telangana as most establishments are in AP. The details provided hereafter are for the combined states and has been referred to as Andhra Pradesh.

**Table I: Details of Thermal power generated by APGENCO**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Power House</th>
<th>No. of Units x capacity (MW)</th>
<th>Installed capacity (MW)</th>
<th>% w.r.t Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kothagudem – A</td>
<td>4x60</td>
<td>240.00</td>
<td>1.44%</td>
</tr>
<tr>
<td>2</td>
<td>Kothagudem – B</td>
<td>2x120</td>
<td>240.00</td>
<td>1.44%</td>
</tr>
<tr>
<td>3</td>
<td>Kothagudem – C</td>
<td>2x120</td>
<td>240.00</td>
<td>1.44%</td>
</tr>
<tr>
<td>4</td>
<td>Kothagudem – D</td>
<td>2x250</td>
<td>500.00</td>
<td>3.01%</td>
</tr>
<tr>
<td>5</td>
<td>KTPS - (Stage - VI)</td>
<td>1x500</td>
<td>500.00</td>
<td>3.01%</td>
</tr>
<tr>
<td>6</td>
<td>Ramagundam – B</td>
<td>1x62.5</td>
<td>62.50</td>
<td>0.38%</td>
</tr>
<tr>
<td>7</td>
<td>Dr NTTPS</td>
<td>6x210+500</td>
<td>1760.00</td>
<td>10.59%</td>
</tr>
<tr>
<td>8</td>
<td>R.T.P.P. Stage 1 (unit - 1 &amp; 2)</td>
<td>2x210</td>
<td>420.00</td>
<td>2.53%</td>
</tr>
<tr>
<td>9</td>
<td>R.T.P.P. Stage 1 (unit - 1 &amp; 2)</td>
<td>2x210</td>
<td>420.00</td>
<td>2.53%</td>
</tr>
<tr>
<td>10</td>
<td>R.T.P.P. Stage 1 (unit - 1)</td>
<td>1x210</td>
<td>210.00</td>
<td>1.26%</td>
</tr>
<tr>
<td>11</td>
<td>Kakatiya TPS Stage 1</td>
<td>1x500</td>
<td>500.00</td>
<td>3.01%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>5092.50</strong></td>
<td><strong>30.65%</strong></td>
</tr>
</tbody>
</table>

**Table II: Details of installed capacity of Hydel power by APGENCO**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Power House</th>
<th>No. of Units x capacity (MW)</th>
<th>Installed capacity (MW)</th>
<th>% w.r.t Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Machkund, Interstate project, Orissa</td>
<td>3x17+3x23</td>
<td>84.00</td>
<td>0.51%</td>
</tr>
<tr>
<td>2</td>
<td>T.B.Station, Interstate project, Karnataka</td>
<td>4x9+4x9</td>
<td>57.60</td>
<td>0.35%</td>
</tr>
<tr>
<td>3</td>
<td>Nizam Sagar</td>
<td>2x5</td>
<td>10.00</td>
<td>0.06%</td>
</tr>
<tr>
<td>4</td>
<td>Upper Sileru</td>
<td>4x60</td>
<td>240.00</td>
<td>1.44%</td>
</tr>
<tr>
<td>5</td>
<td>Donkarayi</td>
<td>1x25</td>
<td>25.00</td>
<td>0.15%</td>
</tr>
<tr>
<td>6</td>
<td>Lower Sileru</td>
<td>4x115</td>
<td>460.00</td>
<td>2.77%</td>
</tr>
<tr>
<td>7</td>
<td>Srisailam Right Bank PH</td>
<td>7x110</td>
<td>770.00</td>
<td>4.63%</td>
</tr>
<tr>
<td>8</td>
<td>Srisailam Left Bank PH</td>
<td>6x150</td>
<td>900.00</td>
<td>5.42%</td>
</tr>
<tr>
<td>9</td>
<td>Nagarjunasagar Right Canal PH</td>
<td>3x30</td>
<td>90.00</td>
<td>0.54%</td>
</tr>
</tbody>
</table>
Table III: Details of power produced by APGENCO in Andhra Pradesh, India

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Power Source</th>
<th>Installed capacity (MW)</th>
<th>% w.r.t Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mini Hydel</td>
<td>12.16</td>
<td>0.07%</td>
</tr>
<tr>
<td>2</td>
<td>Wind</td>
<td>2.00</td>
<td>0.01%</td>
</tr>
<tr>
<td>3</td>
<td>Solar Energy Project</td>
<td>1.00</td>
<td>0.01%</td>
</tr>
<tr>
<td>4</td>
<td>Thermal</td>
<td>509.50</td>
<td>50.65%</td>
</tr>
<tr>
<td>5</td>
<td>Hydel</td>
<td>3817.20</td>
<td>22.98%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>53.72%</td>
</tr>
</tbody>
</table>

Table IV: Details of power produced by joint sector in Andhra Pradesh, India

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Power House</th>
<th>Installed capacity (MW)</th>
<th>% w.r.t Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vijayawada - A Venture of APSBB With M/s. AP Gas Power Corp. Ltd.</td>
<td>272.00</td>
<td>1.637%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>1.637%</td>
</tr>
</tbody>
</table>

Table V: Details of power shared by Andhra Pradesh from Central Sector Projects India
Table VI: Details of power from independent Power Producers (IPP) in Andhra Pradesh, India

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Power House</th>
<th>Installed capacity(MW)</th>
<th>% w.r.t Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M/s GVK, Jangipurdu</td>
<td>216.82</td>
<td>1.31%</td>
</tr>
<tr>
<td>2</td>
<td>M/s GVK-Extm, Jangipurdu</td>
<td>220.00</td>
<td>1.32%</td>
</tr>
<tr>
<td>3</td>
<td>M/s Spectrum, Kakinada</td>
<td>208.31</td>
<td>1.25%</td>
</tr>
<tr>
<td>5</td>
<td>M/s Lanco, Kondapalli</td>
<td>351.49</td>
<td>2.12%</td>
</tr>
<tr>
<td>6</td>
<td>M/s Reliance Energy Ltd</td>
<td>220.00</td>
<td>1.32%</td>
</tr>
<tr>
<td>7</td>
<td>M/s Venagin</td>
<td>370.00</td>
<td>2.23%</td>
</tr>
<tr>
<td>8</td>
<td>M/s Konaseema Gas Power Ltd</td>
<td>444.08</td>
<td>2.67%</td>
</tr>
<tr>
<td>9</td>
<td>M/s Gautami</td>
<td>464.00</td>
<td>2.79%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2404.70</td>
<td>15.02%</td>
</tr>
</tbody>
</table>

Table VII: Details of power from Non-conventional sources in Andhra Pradesh, India

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Power House</th>
<th>Installed capacity(MW)</th>
<th>% w.r.t Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bagasse Based Cogeneration</td>
<td>274.00</td>
<td>1.65%</td>
</tr>
<tr>
<td>2</td>
<td>Biomass Based Power Projects</td>
<td>205.25</td>
<td>1.24%</td>
</tr>
<tr>
<td>3</td>
<td>Biomass Based Cogeneration</td>
<td>29.25</td>
<td>0.18%</td>
</tr>
<tr>
<td>4</td>
<td>Mini Hydel</td>
<td>105.64</td>
<td>0.64%</td>
</tr>
<tr>
<td>5</td>
<td>Wind</td>
<td>564.09</td>
<td>3.40%</td>
</tr>
<tr>
<td>6</td>
<td>Waste Heat Recovery Cogeneration</td>
<td>41.00</td>
<td>0.25%</td>
</tr>
<tr>
<td>7</td>
<td>Municipal/ Industrial Waste Based</td>
<td>53.76</td>
<td>0.32%</td>
</tr>
<tr>
<td>8</td>
<td>Solar Energy</td>
<td>41.75</td>
<td>0.25%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1314.74</td>
<td>7.91%</td>
</tr>
</tbody>
</table>

Table VIII: Details of power from Mini power projects and other sources in AP, India

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Power House</th>
<th>Installed capacity(MW)</th>
<th>% w.r.t Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M/s Sri Vata Power Projects Limited</td>
<td>17.20</td>
<td>0.10%</td>
</tr>
<tr>
<td>2</td>
<td>M/s LVS Power Limited</td>
<td>36.80</td>
<td>0.22%</td>
</tr>
<tr>
<td>3</td>
<td>M/s RVK Energy Pvt Ltd</td>
<td>24.79</td>
<td>0.15%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>78.79</td>
<td>0.47%</td>
</tr>
<tr>
<td>4</td>
<td>Isolated gas wells</td>
<td>27.04</td>
<td>0.16%</td>
</tr>
</tbody>
</table>

Hence the total installed capacity in AP and TS, India is 16613.53MW.

2.1 Ongoing projects

To address power demands currently 3 hydroelectric projects (HEP) and 2 thermal power (TPP) plants are in the process of establishment. Another 4 thermal power plants, 1 hydroelectric project and 1 nuclear power plant are
expected to come up in the future. The details of on-going power projects in Andhra Pradesh state in India are given in table IX [8].

Table-IX: Ongoing power projects in AP, India

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Project</th>
<th>Inst.Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pulichintala HEP</td>
<td>4x30</td>
</tr>
<tr>
<td>2</td>
<td>Nagarjuna Sagar Tail Pond Dam</td>
<td>2x25</td>
</tr>
<tr>
<td>3</td>
<td>Lower Jurala HEP</td>
<td>6x40</td>
</tr>
<tr>
<td>4</td>
<td>Kakatiya TPP</td>
<td>1x500+1x600</td>
</tr>
<tr>
<td>5</td>
<td>Rayalaseema TPP</td>
<td>5x210+1x600</td>
</tr>
<tr>
<td>6</td>
<td>Sri damodaram sanjeevaiah TPS</td>
<td>2x800</td>
</tr>
</tbody>
</table>

III THE CURRENT ENERGY CHALLENGE OF ANDHRA PRADESH, INDIA

3.1 Gas

Since August 2012 the center has cut natural gas supply by two million standard cubic meters per day leading to a generation loss of 400MW. The gas has been diverted to Ratnagiri power. By the end of September 2013, the supply of natural gas from KG-D6 (Krishna Godavari Delta 6) has fallen to 13 million standard cubic meters a day (msc-md) from its peak of 60 msc-md in 2011. This has led to most plants running on losses. The major plants affected by this event are: GVK-I (220MW), Spectrum (220MW), Lanco-II (355MW), BSES (220MW), Konaseema (460MW), GVK Gautami (464MW), GV-KII (220MW) and Vemagiri of the GMR Group (370MW).

Banks are not financing new projects. Around 13,000MW is currently under construction in various stages. Out of the installed 2494.70MW only about 1170MW is being used due to shortage. Around 2400MW of additional capacity is lying idle.

3.2 Coal

Coal which is one of the most widely used sources is equally vulnerable due to the following reasons:

- It is irreplacable and reserves are being exhausted at an alarming rate. At a more realistic growth rate of 5% (CIL and government target 8%) the coal reserves will be exhausted by 2034(2030 at 8% growth).

- The generating stations and the coal plants are controlled by different authorities. Any sort of disagreement among workers of one organization could prove fatal. This effect was recently felt during the Telangana agitations in 2012 when workers of Singareni colleries went on strike. Power plants were worst hit with many plants having stocks lasting less than 4 days. The state witnessed massive load shedding inspite of borrowed power from the other three southern states (Karnataka, Kerala and Tamilnadu). The city of Hyderabad witnessed major business loss with 6-8hr domestic power cuts.
3.3 Nuclear Fuel
There is no running plant in AP, India; the country imports most of its fuel, the major supplier being Russia. There is proposal to set up a nuclear power plant at Kovvada in AP. However nuclear power plants are central government entities and power will be divided instead of the total power coming to the state.

IV ENERGY DEFICIT IN A.P, INDIA
The details of unrestricted demand, demand met and deficit are given in table X [10] and energy procurement by AP in MU is given in table XI down below. [10]

Table X: Energy deficit in AP, India

<table>
<thead>
<tr>
<th>Unrestricted demand(MU)</th>
<th>106,061</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand met(MU)</td>
<td>89,934</td>
</tr>
<tr>
<td>Deficit %</td>
<td>15.2%</td>
</tr>
</tbody>
</table>

Table XI: Energy procurement in MU

<table>
<thead>
<tr>
<th></th>
<th>Estimated Potential(MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>APGENCO Thermal</td>
<td>35,958</td>
</tr>
<tr>
<td>APGENCO Hydel</td>
<td>7,057</td>
</tr>
<tr>
<td>CGS - Thermal</td>
<td>26,740</td>
</tr>
<tr>
<td>Gas</td>
<td>4,137</td>
</tr>
<tr>
<td>Nuclear</td>
<td>3,473</td>
</tr>
<tr>
<td>Renewable</td>
<td>2,431</td>
</tr>
</tbody>
</table>

Though TPP are being established to address energy scarcity, a better solution would be to tap renewable sources as the major cause of the deficit can be attributed to domestic coal shortage and also drop in the gas availability.

V RENEWABLE ENERGY SYSTEMS
The different energy systems being dealt with here are hydrogen energy systems, fuel cells, biofuels, solar, wind, ocean wave, ocean thermal energy, geothermal energy, Osmotic pressure. The details of the estimations are given in table XII.

Table XII: Existing estimated potential of renewable energy resources

<table>
<thead>
<tr>
<th>Source</th>
<th>Estimated Potential(MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Power</td>
<td>5954</td>
</tr>
<tr>
<td>Small Hydro Power</td>
<td>560</td>
</tr>
<tr>
<td>Biomass Power</td>
<td>578</td>
</tr>
<tr>
<td>Cogeneration Power</td>
<td>300</td>
</tr>
<tr>
<td>Waste to Energy</td>
<td>123</td>
</tr>
<tr>
<td>Geothermal energy</td>
<td>1500</td>
</tr>
<tr>
<td>Total</td>
<td>6955 MW</td>
</tr>
</tbody>
</table>
5.1 Solar power

Andhra Pradesh in India falls in the tropical regions with an estimated potential of 5-7KWh/m2. [10] In the total area being 2, 75,069 sq km, [13] according to the agricultural department 7.3% of land (20080.037sq km) [15] is barren and uncultivable. Hence this can be used for setting up a solar plant with minimum carbon footprint without affecting ecological balance. Even if 2000sqkm (less than 10%) of the barren land is used, around 215278.301MWh can be obtained. Solar power is the most established and proven alternative source. Policies of the government also support this source.

5.1.1 Cost of establishing a solar plant

A 1kw solar establishment will cost around Rs50, 000 against one lakh due to 30% central subsid and 20% state subsid. Area occupied by 1kw plant is about 100sft (9.2903x10-6sqkm) and tariff offered to producers is Rs 6.49 per unit and cost of setting up a solar plant is Rs 6.5 to 8 crores (The cost depends upon the plant location i.e. urban, semi-urban or rural). The details are presented in table XIII below as determined by CERC (Central Electricity Regulation commission). [11]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
<th>Capital Cost Norm For Solar PV project (Rs in Lakh/MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PV Modules</td>
<td>325.92</td>
</tr>
<tr>
<td>2</td>
<td>Additional module cost as against degradation</td>
<td>009.79</td>
</tr>
<tr>
<td>3</td>
<td>Land Cost</td>
<td>016.80</td>
</tr>
<tr>
<td>4</td>
<td>Civil and General Works</td>
<td>094.50</td>
</tr>
<tr>
<td>5</td>
<td>Mounting Structures</td>
<td>105.00</td>
</tr>
<tr>
<td>6</td>
<td>Power Conditioning Unit</td>
<td>060.00</td>
</tr>
<tr>
<td>7</td>
<td>Evacuation Cost up to Inter-connection Point (Cables and Transformers)</td>
<td>105.00</td>
</tr>
<tr>
<td>8</td>
<td>Preliminary and Pre-Operative Expenses including IDC and contingency</td>
<td>080.00</td>
</tr>
<tr>
<td></td>
<td>Total capital Cost in Lakhs</td>
<td>797.01</td>
</tr>
</tbody>
</table>

5.2 Ocean Thermal Energy Conversion (OTEC)

The temperature difference between the surface ocean water to the cooler deep water is utilized in running a heat engine and produce electricity. AP lies between 12°41’ and 22°N latitude and the entire coastline lies in the global OTEC region. The peak surface temperatures range from 29 to 31 0C and lowest from 24 to 27 0C.As anomalies’ in the temp difference is observed in the Indian Ocean [5] [6] [7].

Flux corresponding to evaporation =0.95W/m2, Assuming a 3% cycle efficiency over evaporative flux
Area covered by AP territory=22.2x972sqkm=21578.4km²
The energy obtained will be 58320MW

5.3 Wave Energy

Andhra Pradesh has a longest coastline of 972km [13] (in India). Theoretically, the annual wave energy potential along the Indian coast is between 5 MW to 15 MW per meter. AP coast has a wave potential of 5MW/m [9]. Though currently extraction is not possible better technologies in future may allow us to harness (972000x5) 486,0000MW power available in the waves. [9]

5.4 Bio-Mass and Cogeneration

Though estimates are available with the government, fuel sources like poultry litter haven’t been considered. Andhra Pradesh ranks first in poultry. Typically an average broiler chicken generates around 0.9kg of litter [13]. There were 140 million broilers in 1997-98. [12] Hence estimated litter generation is 126x106 kg (138891.1854 tonnes). Assuming statistics from the neighboring state of Tamilnadu, for the plant being run by Subhashree Bioenergies each tonne of litter produces around 2.67x10-3MW. The by-products include 1/6 tonne of manure and 1.67 litres of liquid bio-fertilizer. Using this as a yard stick estimated additional power generated is 370.84MW.

VI CONCLUSIONS

Though some of the challenges are unique to Andhra Pradesh and Telangana, India, many of the issues of energy scarcity are a global phenomenon. An estimation of the resources available will be useful in identifying strategies for establishment of green microgrids. This will be helpful in combating the energy deficit on a regular basis and also during extreme conditions. From the above analysis we conclude that a full harnessment of green energy can replace the existing dependence on fossil fuels and currently at least 60% of the energy can be sourced from renewable sources by replacing fossil based generation in a phased manner. This model in future may be applied to other states in India and also in the world to achieve energy independence. This analysis can also be used by both the state policy makers to propose a sharing agreement to strengthen ties and overcome the current hostile environment.

VII ACKNOWLEDGEMENT

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AN ENHANCED LOSSLESS IMAGE COMPRESSION
BASED ON HIERARCHICAL PREDICTION
CONTEXT ADAPTIVE CODING

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ABSTRACT
To display high bit resolution images on low bit resolution displays, bit resolution needs to be reduced. Towards achieving a reduced bit rates and high compression gain, an enhanced method for compression of various color images are presented, which is based on hierarchical prediction and adaptive coding. An RGB image is first transformed to YCbCr by a reversible color transform and a various conventional lossless grayscale image compression techniques which encodes Y component. A hierarchical decomposition that enables the use of upper pixels, left pixels, and lower pixels for the pixel prediction to encode the chrominance channel. The prediction error is measured based on context model and the adaptive coding is applied to the error signal. Parameters such as peak signal to noise ratio, encoding, decoding time and bit rate have been evaluated and it is exposed that the proposed method further reduces the bit rates compared with JPEG2000 and CALIC.

Keywords-Context adaptive arithmetic coding, Hierarchical decomposition, Lossless RGB image compression, Pixel prediction, Reversible color transform.

I. INTRODUCTION
Along with the increasing attractiveness of digital cameras, the number of digital photos is considerably growing, and the resolution of digital images is also quickly increasing. In order to handle a huge amount of data, different image compression methods have been proposed over the past twenty years. Image compression can be classified into lossy and lossless compression. The lossy compression methods achieve high compression gain at the cost of image quality degradation. Lossless compression, which allows the original data to be exactly reconstructed, has been gaining a high popularity these years. Hence efficient lossless compression become more significant, though the lossy compressed images are usually satisfactory in many cases.

Along with the consistency, many lossless image compression algorithms have been proposed. Among a variety of algorithms, the most extensively used ones are Lossless JPEG LS [5], JPEG [2], LOCO-I [7], CALIC [3], JPEG2000 [6] and JPEG XR [14]. LOCO is the technique at the core of the new ISO standard for lossless and near-lossless compression of continuous-tone images. Context adaptive lossless image codec (CALIC) obtains
higher lossless compression of continuous tone images than other techniques. A distinctive feature of CALIC is the use of a large number of modeling contexts to condition a non linear predictor and make it adaptive to varying source statistics. In the procedure of JPEG standardization, the LOCO-I and CALIC were developed, where most thoughts in LOCO-I are accepted for the JPEG-LS standard though the CALIC provides better compression act or performance at the cost of more computations.

For the lossless color image compression, the RGB components are first decorrelated by a reversible color transform, and each of the transformed components are separately compressed by the above mentioned methods. Generally, RGB image has high density and highly correlated and it cannot be compress capably and it is decorrelated to YCbCr (Combination of luminance and chrominance image) by using reverse color transform.

The dissimilarity between YCbCr and RGB is that YCbCr represents color as brightness and difference between two color signals, while RGB represents color combination as red, green and blue. Y is the brightness (luma), Cb is blue minus luma (B-Y) and Cr is red minus luma (R-Y) in YCbCr. However, in the case of lossless compression, most color transforms cannot be used due to their non invertibility with integer arithmetic. Hence an invertible edition of color transform, the reversible color transform (RCT) was mentioned and used in JPEG2000 [6]. Many researchers have been there for finding better RCTs [11], among which we take up a transform proposed in [12] because it approximates the conventional YCbCr transform very well. The idea of this paper is to expand a hierarchical prediction scheme and most of an existing prediction method in lossless image compression are based on the conventional raster scan prediction which is sometimes bungling in the high frequency region. The “hierarchical” prediction for the compression was already proposed in [1], but only pixel interpolation is used here.

An edge detection and context adaptive model for this hierarchical scheme is designed in this paper. For the prediction of a pixel to be encoded, here we propose a method that can use lower row pixels as well as the upper and left pixels. For the compression of color images, the RGB is first altered to YCuCv by an RCT and Y channel is determined by a conventional grayscale image compression algorithm. The signal variation is generally much smaller than that of RGB, but still large near the edges in the case of chrominance channels (Cu and Cv). For more precise prediction of these signals, and also for accurate modeling of prediction errors, we use the hierarchical scheme, the chrominance image is splitted into two subimages; i.e. a set of even numbered rows and a set of odd numbered rows respectively. Once the even row subimage Xe is pre-arranged, we can use all the pixels in Xe for the prediction of a pixel in the odd row subimage Xo. In addition, since the statistical properties of two subimages are not much dissimilar, the probability density function of prediction errors of a subimage can be exactly modeled from the other one, which contributes to better context modeling for arithmetic coding. Various kinds of images are performed, and it is shown that the proposed method provides higher coding gain than JPEG2000 and JPEG-XR (existing methods) in many cases.

II. HIERARCHICAL SCHEME AND PIXEL PREDICTION

In this hierarchical decomposition, the chrominance channels Cu and Cv which results from the RCT usually have different figures from Y (luma), and also different from the original color planes R, G, and B. The overall signal variation is concealed by the color transform in the chrominance channels, but the variation is still large near the object boundaries. Consequently, the prediction errors in a chrominance channel are much reduced in a smooth
region, but remain reasonably great near the edge or within a texture region. The pdf of prediction error for better context modeling, along with the accurate prediction is estimated for the efficient compression. Here, we propose a hierarchical decomposition scheme that is pixels in an input image $X$ is split into two subimages: an even subimage $X_e$ and an odd subimage $X_o$. An even subimage is encoded first and is used to predict the pixels in odd subimage $X_o$. In addition, $X_e$ is also used to find the statistics of prediction errors of $X_o$. For the compression of $X_o$ pixels using $X_e$, directional prediction is worked to avoid large prediction errors close to the edges. For each pixel, the horizontal predictor $\hat{x}_h(i, j)$ and vertical predictor $\hat{x}_v(i, j)$ are defined as

$$\hat{x}_h(i, j) = x_e(i, j - 1)$$
$$\hat{x}_v(i, j) = \text{round}\left(\frac{x_e(i, j) + x_e(i + 1, j)}{2}\right) \quad (a)$$

**Algorithm (a)**: To find the direction of $i,j$

```plaintext
if $|x_e(i, j) - \hat{x}_h(i, j)| < |x_e(i, j) - \hat{x}_v(i, j)|$
then
    $\text{dir}(i, j) \leftarrow H$
else
    $\text{dir}(i, j) \leftarrow V$
end if
```

and one of them is selected to predict $x_o(i, j)$. The most important one is the horizontal predictor will be more accurate only when there is a strong horizontal edge.

To implement this idea, we define a variable for the direction of edge at each pixel $\text{dir}(i, j)$, which is given either Horizontal or Vertical. To decide the direction of $i, j$ and it is explained in Algorithm (a).

**Algorithm (b)**: To calculate the overall pixel prediction

```plaintext
if $\text{dir}(i-1, j)=H$ or $\text{dir}(i, j-1)=H$ then
    Calculate $\text{dir}(i, j)$ by algorithm (a)
    Program $\text{dir}(i, j)$
    if $\text{dir}(i, j)=H$ then
        $\hat{x}_o(i, j) \leftarrow \hat{x}_h(i, j)$
    else
        $\hat{x}_o(i, j) \leftarrow \hat{x}_v(i, j)$
    end if
else
    $\hat{x}_o(i, j) \leftarrow \hat{x}_v(i, j)$
end if
```

984 | Page
III. PROPOSED CODING SCHEME

In this proposed coding section, the overall procedure of image compression has been explained. First, an input RGB color image is transformed into $YCbCr$ which is a combination of luminance and chrominance color space by an reversible color transform. The conventional compression methods such as CALIC and JPEG-LS which encodes the luminance image $Y$. The chrominance channel $C_u$ and $C_v$ are encoded using the method hierarchical decomposition and pixel prediction.

First, a chrominance part $X0 \in \{Cu,Cv\}$ is decomposed row by row into an even subimage $X0(1)$ and an odd subimage $Xo(1)$. The odd subimage $Xo(1)$ is predicted and encoded using even subimage $Xe(1)$, as described in Section(b) and then a subimage $Xe(1)$ can be further divided column by column into the even subimage $Xe(2)$ and the odd subimage $Xo(2)$.

The effective encoding of the prediction error $e(i, j)$ in the predictive lossless image compression plays a vital role. Though the proposed pixel prediction method frequently generates small prediction errors due to the RCT, there are still comparatively large errors close to the edge or texture region, which degrades the performance of compression.

For the efficient compression, prediction errors should well be explained by a correct model. We construct the prediction error as a random variable with probability density function $P(e|Cn)$, where $Cn$ is the coding local activity that reflects the magnitude of edges and textures. In particular, $Cn$ is denoted as the level of quantization steps of pixel activity $\sigma(i, j)$ defined as $\sigma(i, j) = |xe(i, j) - xe(i + 1, j)|$. Figure (1) shows an input image and it compares the magnitude of an error with probability of an error and the local activity of a subimage called as (context), and $P(e|Cn)$ for several $Cn$. It explains the statistical property of prediction error very well, in that the magnitude of error is large only when the local activity (context) is strong. Therefore the proposed technique can be effective for the compression with adaptive arithmetic coding.

IV. SIMULATION RESULTS

The algorithm is applied on various test images, which is widely used for the lossless compression. In all the simulation, the parameter $T1$ in Algorithm (b) and number of contexts are assigned to 2 and 4. The conditional probability density function has been simulated as shown in Fig.1. The tool used for simulation is Matlab with operating system Windows Xp, 7.

The classic images which has a combination of Red, green and blue and it is transformed into $YCbCr$ then compression is done and arithmetic coding has been applied to find bit rate and PSNR. The simulation results are summarized in Table I which compares the compressed bit rates with existing methods such as CALIC, JPEG 2000 and JPEG XR. It shows higher compression gain than the JPEG-LS and LOCO-I. at the cost of higher computational complexity. For the lossless compression of color image, the JPEG2000 and JPEG-XR [14] provides better coding gain than CALIC and also than the encoding by CALIC after RCT.
Fig. 1 An example of local activity (context) and probability of error depending on context.

Table I

<table>
<thead>
<tr>
<th></th>
<th>SIZE</th>
<th>CALIC</th>
<th>JPEG2000</th>
<th>JPEG XR</th>
<th>PROPOSED</th>
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</thead>
<tbody>
<tr>
<td>Peppers</td>
<td>512×512</td>
<td>13.866</td>
<td>14.100</td>
<td>15.324</td>
<td>9.07031</td>
</tr>
<tr>
<td>Eye</td>
<td>512×512</td>
<td>13.851</td>
<td>15.959</td>
<td>18.555</td>
<td>10.664</td>
</tr>
<tr>
<td>Strawberry</td>
<td>512×512</td>
<td>14.956</td>
<td>11.612</td>
<td>15.144</td>
<td>13.892</td>
</tr>
</tbody>
</table>

The peak signal to noise ratio is measured for various images which are summarized in Table II.

Table II

<table>
<thead>
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<th></th>
<th>Size</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lena</td>
<td>512×512</td>
<td>13.550032</td>
</tr>
<tr>
<td>Peppers</td>
<td>512×512</td>
<td>7.731209</td>
</tr>
<tr>
<td>Eye</td>
<td>512×512</td>
<td>7.196240</td>
</tr>
<tr>
<td>Strawberry</td>
<td>512×512</td>
<td>6.605782</td>
</tr>
</tbody>
</table>
Fig. 1. The Classic images set 1

Fig. 3. The Classic images set 2

Fig. 4. The Classic images set 3

Fig. 5. The Classic images set 4

CPU Times (Seconds) – Encoding and Decoding Time

<table>
<thead>
<tr>
<th></th>
<th>Encoding time</th>
<th>Decoding time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lena</td>
<td>11.657924</td>
<td>12.908366</td>
</tr>
<tr>
<td>Peppers</td>
<td>12.148840</td>
<td>13.023052</td>
</tr>
<tr>
<td>Eye</td>
<td>8.7065243</td>
<td>9.644510</td>
</tr>
<tr>
<td>Strawberry</td>
<td>10.316191</td>
<td>8.009343</td>
</tr>
</tbody>
</table>

COMPRESSED IMAGES
Finally, for set of images the encoding time and decoding times are measured which are summarized in Table III. Since this method employs JPEG2000 and needs additional steps for hierarchical prediction and context modeling, it requires slightly more computation time than the JPEG2000.

Performance Analysis

(i) Mean Square Error

Mean square error is defined as cumulative error between original image and compressed image

\[ MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i, j) - K(i, j)]^2 \]

(ii) Peak Signal To Noise Ratio

It is used to measure the quality of reconstruction of lossy and lossless compression (e.g., for image compression). The amount of signal in the original data, and the noise is the error introduced after compression. When comparing compression codecs, PSNR depends on human perception of reconstruction quality. The reconstruction quality will be good if system has higher PSNR. PSNR is most measured through the mean squared error can solve the unattended RTS problem and improve the pipeline efficiency.

\[ PSNR = 10 \cdot \log_{10} \left( \frac{M A T^2}{M S E} \right) \]

V. CONCLUSION

An enhanced lossless RGB image compression based on hierarchical prediction and context adaptive coding has been proposed to reduce the bit rate and to achieve high compression gain. The color image is first converted to \( YCUCV \) by reversible color transform in which the chrominance channel is encoded based on pixel prediction, hierarchical decomposition and conventional compression method encodes luminance component \( Y \). The prediction error is measured based on context model and the adaptive coding is applied to the error signal. Parameters such as peak signal to noise ratio, encoding, decoding time and bit rate have been evaluated. The proposed method and several conventional methods have been tested on the various images and shown that average bit rate reductions over JPEG2000 for these set of images are shown to be 7.20%, 13.22% and 6.1%.

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A BRIEF STUDY ON TRUTH BEHIND UFO MYSTERIES

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Narote Mounika\textsuperscript{4}, Agnihotra Reddy.C\textsuperscript{5}, V.N.Sai Kiran Aka\textsuperscript{6}

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ABSTRACT

UFO reports have been evaluated in terms of the supposed reliability of eyewitness accounts and questionable photographic evidence. The constraints that interstellar distances, time and the conservation of energy impose on interstellar space travel for these supposed alien craft seem never to be considered by UFO proponents. They do provide descriptions of spacecraft of circular disks, cylinders and triangles that move strangely and rapidly and vary in size from 50 feet in diameter to 300 feet long. It important to consider not just the accounts of alien contact, but the physics of such a possibility as well.

Keywords : Time travel, Quantum Teleportation, Motivation, Space and Nasa.

I INTRODUCTION

1.1 UFO sightings by astronauts

THE MOON IS A FOREIGN NATION

Apollo Moon astronauts were often followed to the Moon, at times, by U.F.O.s. Official N.A.S.A. Apollo 12 photograph AS12-497319 clearly Shows a large U.F.O. hovering over an astronaut walking on the Moon.

The government agencies policies of keeping U.F.O.s secret from the general public is well-known and has been well-documented in several books by famous astronomers like J. Allen Hynek (who investigated U.F.O.s for the U.S. Air Force), Major Donald Keyhoe, Timothy Good (in his book Above Top Secret), and many other professionals. One unquestionably absolute expert we may want to consult is Christopher Kraft, who was director of the N.A.S.A. tracking base in Houston during the Apollo Moon missions, when he revealed the following conversation “after” he left his work at N.A.S.A.:

- ASTRONAUTS NEIL ARMSTRONG and BUZZ ALDRIN speaking from the Moon: “Those are giant things. No, no, no .... this is not an optical illusion. No one is going to believe this!”
- MISSION CONTROL (HOUSTON CENTER): “What...what...what? What the hell is happening? What’s wrong with you?”
- ASTRONAUTS: “They’re here under the surface.”
MISSION CONTROL: “What’s there? Emission interrupted... interference control calling Apollo II.”
ASTRONAUTS: “We saw some visitors. They were there for awhile, observing the instruments.”
MISSION CONTROL: “Repeat your last information.”
ASTRONAUTS: “I say that there were other spaceships. They’re lined up on the other side of the crater.”
MISSION CONTROL: “Repeat...repeat!”
ASTRONAUTS: “Let us sound this orbita ..... In 625 to 5...automatic relay connected... My hands are shaking so badly I can’t do anything. Film it? God, if these damned cameras have picked up anything... what then?”
MISSION CONTROL: “Have you picked up anything?”
ASTRONAUTS: “I didn’t have any film at hand. Three shots of the saucers or whatever they were that were ruining the film.”
MISSION CONTROL: “Control, control here. Are you on your way? Is the uproar with the U.F.O.s over?”
ASTRONAUTS: “They’ve landed there. There they are and they are watching us.”
MISSION CONTROL: “The mirrors, the mirrors...have you set them up?”
ASTRONAUTS: “Yes, they’re in the right place. But whoever made those space ships surely can come tomorrow and remove them. Over and out.”

It is logical that if government agencies keep the existence of U.F.O.s from outer space secret from the public, if they discovered the home of the U.F.O.s that would obviously be secret also, and they would have to release “cover stories” about the Moon to hide the truth. The problem has been that witnesses have “talked” to our Department of interplanetary Affairs.

Among the experts who told us about life on the Moon and the discoveries of the astronauts were:

- Farida Iskiovet, former U.F.O investigator for the President of the United Nations
- a mysterious Mr. English who did TOP SECRET photography for N.A.S.A.
- the moon astronauts:
  - Commander Mark Huber formerly of Naval Intelligence who knew much top secret data
  - Sgt. Willard Wannal (formerly Army Intelligence)
  - Major Wayne S. Aho (formerly Army Intelligence who submitted U.F.O research to Congress)
- Dr. James Hurrah from the N.A.S.A. space program
- and others who have secret identities. I personally spoke to all of the above leaks and investigators
Suspicion or interest in life on the Moon grabbed public attention when the inventor of the radio (so credited) Marconi, Tesla publicly reported his experiments in transmitting radio signals to the Moon and attempting to receive answers, which he indeed believed took place. After that, American, British, and French astronomers reported glowing and moving and sometimes even blinking lights on the Moon during the 1920s and 1930s, often reported in local newspapers and scientific journals of those years which can often be found in major libraries. This interest peaked when a respected expert in aerial phenomenon, Pulitzer Prize winning astronomer John O’Neill, publicly reported observing the “bridge” on the Moon that appeared artificially constructed by intelligence. There were other witnesses to the twelve mile long “bridge” which was erected because it was not seen in the same place before, and was later dismantled for unknown reasons (was it too conspicuous?). The bridge sighting occurred in the early 1950s.

II BRIEF EXPLANATION

2.1 Area 51 whistleblower Bob Lazar appearing at the 2015 International UFO Congress

1. In 1989, Bob Lazar came forward to assert that he had worked on reverse-engineering alien technology at a secret facility in Nevada called S-4 that was built into a mountainside just south of Area 51’s main site. The world was introduced to Area 51, and to Bob Lazar, by KLAS investigative reporter George Knapp who interviewed Lazar about his claims. Now, twenty-five years later, both Knapp and Lazar will be reuniting for a special appearance at the world’s largest annual UFO conference—the International UFO Congress. The assertions made by Lazar are well-known staples in UFO lore, and they served as a catalyst for Area 51’s rise to pop culture prominence. He alleges that he was expelled from working at Area 51 after it was discovered that he had told friends where they could watch test flights of the advanced extraterrestrial technology on which he was working. Although many believe Lazar’s assertions, critics dismiss his claims, citing the lack of supporting evidence, including the absence of employment and education records. But Lazar, who asserts the government erased his records, stands by his claims.

2.2 8 News NOW

1. Knapp and Lazar reunited in May 2014 on the twenty-fifth anniversary of their first interview. Lazar’s story remains the same now as it was when he told it twenty-five years ago. Although he has his critics, Lazar recently told Knapp that he really doesn’t care if anyone believes him or not. He is not trying to convince anyone, and he has tried to leave UFOs in his past.

2. In their recent interview, Lazar, who currently runs a scientific equipment and supply store in Michigan with his wife called United Nuclear, explains to Knapp, “This is not a business of mine. I am trying to run a scientific business, and if I’m the UFO guy, it makes it really difficult, it is to my benefit that people don’t believe the story.”
3. Although he has largely avoided speaking about his Area 51 experiences in public, both Lazar and Knapp will appear at the International UFO Congress in Fountain Hills, Arizona on Saturday February 21. Knapp will present a lecture, followed by an hour-long question-and-answer session with Lazar.

2.3 How Quantum Teleportation Works

1. Teleportation is no longer science fiction - thanks to quantum mechanics scientists can teleport information securely from one place to another. The latest episode of Quantum Around You explains how. When most people think about teleportation, they think about someone disappearing in one spot and appearing in another instantly, Star Trek style. While that would be extremely useful, so far scientists haven't found a way to do it.

2. But what they have managed to do is teleport information, and in some ways that’s even cooler. Quantum teleportation, as its known, is a crucial area of research because it’s the only way humans can transmit information completely securely, with no risk of interception.

3. To do this, scientists exploit the special characteristics of quantum entanglement. You may have heard of it before, but the latest episode of University of New South Wales (UNSW)'s Quantum Around You does an amazing job of breaking down the physics behind the process.

As Associate Professor Andrea Morello, from the School of Electrical Engineering and Telecommunications at UNSW, explains, quantum entanglement is when two electrons become linked and lose their individuality. This means their state or “spin” - which can either be up or down - is defined only as being the opposite of each other. If you split up two entangled electrons, the person with one can suddenly able to transmit information from one to the other.

4. That means you could encode information on a single electron (an up spin could mean one thing while a down could mean another, or more commonly, up could represent a ‘1’ in the binary code, while down represents a ‘0’), and the person with the other entangled electron would be able to access that information by looking at what state their electron is in.

5. So how is that teleportation? What many people don't realise is that as soon as that information is transmitted, it disappears from the electron of the sender and instantly reappears on the recipient's electron. Ta da! This is because the sender has to use another, non-entangled electron to read the information properly, and as soon as they do this the entanglement is lost.

6. But even though this is a pure example of teleportation, it doesn’t actually contradict Einstein’s theory of relativity, which states nothing can move faster than the speed of light. scientists are making information disappear and reappear all over the world.
Figure 1

7. Depiction of the University of Innsbruck experimental setup for achieving quantum teleportation. In the quantum teleportation process, physicists take a photon (or any other quantum-scale particle), transfer its properties (such as its polarization, the direction in which its electric field vibrates) to another photon—even if the two photons are at remote locations. What's important to emphasize is that this scheme doesn't allow physicists to teleport the photon itself—only its properties to another, remote photon. At the sending station of the quantum teleporter, Alice encodes photon M with a specific state: 45 degrees polarization. This travels towards a beamsplitter. Meanwhile, two additional "entangled" photons are created. The polarization of each photon is in a fuzzy, undetermined state, yet the two photons have a precisely defined interrelationship. Specifically, they must have complementary polarizations. For example, if photon A is later measured to have horizontal (0 degrees) polarization, then the other photon must "collapse" into the complementary state of vertical (90 degrees) polarization.

8. Entangled photon A arrives at the beamsplitter at the same time as the message photon M. The beam splitter causes each photon to either continue towards detector 1 or change course or travel to detector 2. In 25% of all cases, in which the two photons go off into different detectors, Alice does not know which photon went to which detector. This inability for Alice to distinguish between the two photons causes quantum weirdness to kick in. Just by the very fact that the two photons are now indistinguishable, the message photon M loses its original identity and becomes entangled with A. The polarization value for each photon is now indeterminate, but since they travel towards different detectors Alice knows that the two photons must have complementary polarizations.
9. Since message particle M must have complementary polarization to particle A, then the other entangled particle B must now attain the same polarization value as M. Therefore, teleportation is successful. Indeed, Bob sees that the polarization value of particle B is 45 degrees: the initial value of the message photon. In the experimental version of this setup executed at the University of Innsbruck, the 45-degree polarization detector would always fire when detector 1 and detector 2 fired. Except in rare instances attributable to background noise, it was never the case that the 135-degree polarization detector fired in coincidence with detectors 1 and 2. Note that this scheme is intended only for quantum-scale particles, such as photons and atoms. Although no existing laws of physics prevent quantum teleportation from being carried out in humans and automobiles, it is extremely unlikely that this scheme could be carried out in such macroscopic objects, because the uniquely quantum properties (such as entanglement) that make teleportation possible quickly break down as objects scale up to the macroscopic sizes.

10. Also, quantum teleportation does not allow for faster-than-light communication. Although the teleported particle attains the polarization value instantly, the people at the sending station must convey the fact that teleportation was successful by making a phone call or using some other light speed or sub-light-speed means of communication. In this setup, teleportation is achieved 25% of the time, corresponding to the percentage of times in which the two photons travel off to two different detectors, a condition which necessitates the two photons to have complementary polarizations. In more advanced schemes, in which Alice has a more elaborate measuring station, teleportation would be achieved more frequently and the detectors would provide information allowing the person at the sending station to give instructions to the receiving station (again, via a phone call) on how to massage the target particle into the desired state.
2.4 Time Travel and UFO Connection

Chrononauts - An Evolutionary Angle

From an evolutionary standpoint, some enthusiasts and researchers consider the notion that if today's pop, iconic aliens really do exist, then they are likely our own descendants from many thousands of years in the future. In this case, they may or may not still be technically extraterrestrial, if only because some of our indeterminably distant grandchildren may well be born on another planet. People frequently put forth the idea that "visitors" or "grays" are quasi-humans with inter-dimensional maneuverability of some kind. Without entirely ruling out ideas involving alternate or additional realities, focus, however, on certain consistently purported continuities of physiological traits between them and ourselves. These suggest a relatively simple origin much closer to home - one in which time, itself, presents the only real space separating this "alien" civilization from our own. On the subject of their having come from another star system all together, the whole "astronomical time & distance to the nearest possible source..." argument becomes moot on an evolutionarily backlit stage. Extraterrestrial hypotheses regarding humans' own beginning are not very viable, either, considering the ever-expanding paleoanthropological evidence from our fossil record. This applies to the entire postmodern physique, hypothetically making us a veritable missing link in ourselves. Although scientists speculate that humans may evolve an even larger nose to adapt to airborne pollution, it is easy to envision standardized residential air filtration of some sort becoming a vital norm in the relatively near future. In a quite typical evolutionary response to increased reliance upon man-made apparatus, the nose may gradually recede, possibly even being a consequence of subterranean or submarine living with such respiratory support.
2.5 Travel

1. One of the main reasons cited against extraterrestrial involvement is the extreme distances they would have to cross in a reasonable amount of time. If “aliens” are time travelers, then no distance to cross is required. The counter-argument to that is “if the universe is expanding, the position of the earth in the universe in 1999 is going to be greatly different than it’s position in 2004. Thus, time travelers would find themselves millions of miles off course”.

2. Response to that would be in the form of an analogy. Take a balloon, and imagine that it represents the universe, and the surface is the fabric of space and time. Make a dot on the balloon. This dot represents a particular point in space at a certain time (say the present). Now inflate the balloon (if the universe is expanding, you’ve just moved into the future). Not only does the mark stretch a bit; it also changes position in three-dimensional space. However, since the entire balloon stretched the same amount, that mark still refers to the exact same point on the balloon as when it was deflated.

3. Thus, a point in space is the exact same point in different times, even if the universe expands. If the time travelers are using wormholes fixed in space but not in time, and the wormhole is anchored to a position in space a few miles away from the moon, then, whatever time they go to, they will always be the same distance from the moon (provided the moon hasn’t changed it’s position in the universe).

2.6 Space

1. What about all the sightings of UFOs that are either (a) in space, or (b), appearing to fly off into space? We can give a couple of reasons as to why time travelers would want to do this.

2. Firstly, there aren’t enough people in space to witness their appearance and disappearance on a regular basis, thus allowing them to arrive and vanish undetected.

3. Secondly, their method of travel may employ a wormhole and they may not wish to draw portions of our atmosphere with them to their time (for reasons concerning contamination). And thirdly, I’m probably not up to date on all the advancements concerning our theoretical understanding of wormholes and black holes, but I’ve never read anything stating that wormholes couldn’t have gravitational pull, similar to a black hole. It may be a physical requirement (or simply, for safety’s sake), to only open wormholes in a vacuum, space being the most convenient for time travel.

Opening one on earth or in its atmosphere may cause problems.

2.7 Physiology

The descriptions of “aliens”, as being grey-skinned, thin-bodied, big-headed beings definitely doesn’t sound human. But it’s human enough.
Since most abduction claims involve medical experiments, one would imagine that everything on board the ship would be sterile. Also, human travelers from the future would most likely not want to expose modern-day humans to potential viruses from the future, as well as they themselves not wanting to put themselves at risk with all of our germs.

If you traveled back in time to Europe during the days of the black plague, how long do you think you, with your twentieth-century immune system, would survive?

The “alien” appearance of these time travelers may simply be contamination suits. Modern-day suits are particularly bulky, but they may evolve to be more form fitting over time as new materials are invented. The funny shaped head could just be a mask or helmet. The bulkiness of that could be attributed to some sort of virtual reality system built into those large, black view-ports that allow the “aliens” to perform medical procedure with the aid of a computer.Interestingly enough, the movie “Fire In The Sky”, which was based on a true story (supposedly), involved an abducted individual who woke up on the alien ship, and discovered space suits that looked just like those “grey” aliens. If any of this is true, it lends credence to hypothesis.

The reports that aliens speak without moving their mouths (generally believed to be telepathy) may simply be a speaker system between the human’s head and helmet. Also, keep in mind that aliens didn’t always have an “alien” appearance. Until the popular “grey” alien concept emerged into society’s consciousness, the UFOs of yesteryear often had human occupants. During the airship flap of the last few decades of the nineteenth century, several airship sightings were reported containing individuals who appeared to be, and claimed to be humans. If we are to take these reports as anything but a hoax, we must be willing to accept that these might have been time travelers from the future, having fun with some of the locals of that era.

Most of these airship sightings took place in the United States, which is important to hypothesis later on.

2.8 Motivation

1. Why are extraterrestrials traveling vast distances so that they can covertly abduct human beings and produce bizarre crossbreeding experiments?
2. If they have such a disregard for human life, why not just conquer and cage us for use later? Why would they bother forming pacts with the American government for the permission to abduct its citizens?
3. Now, the answers to the last two questions are generally given as follows: A UFO crashes and is retrieved by the military. The aliens, knowing that their secret is out agree to supply the military with alien technology provided that the military look the other way when they do their abductions and keep their mouths shut.

If the aliens can just “turn off” people (as is reported during abductions),

- Why not just turn off all the military personnel, retrieve their crashed ship, and continue the experiments?
Why not make everyone in the military that knows the truth forget about it, just like they seem to make abductees forget about their experience?

If their goal is to do their work without interfering with the natural evolution of our planet, then they screwed up royally. For starters, they have to give technology to the leaders of the planet (if you follow that hypothesis). Secondly, their methods of making people forget is faulty; people remember their abductions, and as a result, our very culture has been irrevocably changed by their presence. Now, if these “aliens” are time traveling humans, things make a little more sense. Humans have a romantic fascination with doing things covertly, and that it will not change in the future, thus, the “alien” need for secrecy, etc.

As for the bizarre experiments? Perhaps, some sort of disease has swept through humanity in the future, and mankind’s only hope is to procure untainted genetic samples from humans in the past. Maybe all the countries on Earth in the future are attempting to find a cure first and save their respective populations, thus there may be some sort of “time race” (like our “arms race”) between them, explaining why abduction is a world-wide phenomenon.

Let’s suppose that these time travelers are Americans from the future. They’d love to make a deal with their government of the past, as would the government love to make a deal with the America of the future, especially if it involved obtaining knowledge of the future. The possibilities are endless, but there is only one answer to the reason behind these activities. And it’s probably something that only a select group of people from our time know.

That some people believe aliens have abducted them is not questionable. Whether or not these events take place exactly as the abductees remember them is subject to question. If, though, they are accurate recollections, everyone consider the possibility that these “aliens” are in fact time travelling humans from the future. A prospect, as far-fetched as it sounds, is only as far-fetched as the notion that aliens from a distant world have come here to steal sperm from men, impregnate women, and form secret pacts with our governments.

III CONCLUSION

Perhaps these humans of the future want to look at their beginnings, just as any one of us would probably like to see the first human civilization. Thus we have encounters with “aliens.” This would explain why they appear to come from other planets in spaceships: they really do. This is a rather brief look at a theory that encompasses many ideas that exist only in theory. It makes us think and ponder what we would come up with as a people if there were no limits. There are no real limits that we cannot overcome in time, and therefore all described here is possible.

Time Travelers from the Future: Our legends and folklore are filled with stories about UFO sightings and contacts with aliens from other worlds. Is it possible that these stories are not about time travelers from a distant world... but instead... that they are time travelers from our own future! In these alien sightings the creatures have many human characteristics... is it possible that they are time travelers from our own planet... visiting us from thousands of years in the future?! History is filled with many stories and legends about visitors from time, and also of experiments in time.
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REVIEW ON SYNTHESIS OF SELECTED
MESOPOROUS PARTICLES

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ABSTRACT
The mesoporous particles include organosilicas, highly dispersed tungsten particles, mesoporous carbons, TiO₂ and Al₂O₃ particles. Typical methods of synthesis include use of surfactants like CTAB and polymer like Polyethylene oxide-polypropylene oxide-polyethylene oxide (PEO-PPO-PEO). The solution is usually maintained at basic conditions. Calcination temperature ranges between 350–850°C. forms an important step in the synthesis of Tungsten particles. Other methods include use of evaporation-induced organic-organic self-assembly or sometimes a sol-gel approach from a mixture of poly (ethylene glycol) –poly (propylene glycol)-poly (ethylene glycol) tri-block copolymer. Characterization of the mesoporous particles were carried out by N₂-adsorption-desorption method and analytical methods like FTIR, SEM, TEM, Wide-angle XRD, UV-Visible Diffusive Reflectance Spectroscopy etc. Certain notable applications of the particles include use of Mesoporous organosilicas as a stationary phase in HPLC for the separation of aromatic hydrocarbons and use of highly dispersed tungsten particles as a desulfurizing agent to remove sulphur from diesel. Broader scope of applications includes use of these particles as catalysts for various processes. This paper is intended to review the techniques available for the synthesis of these mesoporous materials.

Keywords: Mesoporous, Organosilica, Polymer, Surfactant, Sol-Gel

I INTRODUCTION
Any material with pore diameter in the range of 2 to 50 nm is considered as mesoporous material. Various materials whether naturally available or synthesised are classified into several kinds by their particle size or pore size. We are interested in the pore size or pore diameter range in our work. A typical illustration of pore size measured materials include microporous materials which have pore diameters of less than 2 nm and macroporous materials which have pore diameters of greater than 50 nm and the mesoporous category thus lies in the middle. Various mesoporous materials include some kinds of silica and alumina. Certain oxides of Niobium, Tantalum, Titanium, Zirconium, Cerium and Tin are also found to be mesoporous in nature. In a mesoporous material synthesised, mesostructure obtained can be ordered or dis-ordered depending on the preparation conditions.

II SYNTHESIS OF MESOPOROUS PARTICLES
2.1. Mesoporous carbon
Ordered porous materials due to their high specific area, large pore volume and pore diameter have attracted
greater technological interest with applications including adsorption. Among the porous materials, mesoporous carbon consisting of 3D porous networks are believed to be more advantageous than materials having cubic pore structure with an ordered array of pores. There are many methods to synthesise such materials. Prominent methods include “the one pot method” [1], where a tri-block copolymer (Pluronic P123) was used as structure directing template and n-butanol was used as a co-solvent. Typical synthesis include self-assembly method where a known amount of P123 was dissolved in water and HCl and n-butanol, followed by addition of H₂SO₄, sucrose and Tetraethylorthosilicate (TEOS), which were used as sources, was added to the solution which was stirred and aged hydrothermally. As synthesised Silica/P123/n-butanol/sucrose was carbonised under N₂ atmosphere at 900°C and dissolution of silica was removed by HF in water. Template-free mesoporous carbon was thus obtained.

Another popular method is the use of “evaporation-induced-organic self-assembly method” [2] where a mixture of a x g of P123 and (1–x) g of Poly(propyleneoxide)-poly (ethyleneoxide)-poly (propyleneoxide) (PPO-PEO-PPO) tri-block copolymer was dissolved in a known amount of ethanol. Low molecular weight phenolic resol precursors were prepared by melting phenol followed by addition of NaOH and addition of formalin drop wise and the mixture was stirred at 75°C for 60 min. After cooling the mixture to room temperature, pH of the reaction mixture was adjusted to neutral using 2 M HCl. Final product was re-dissolved in ethanol and was added drop wise to the above ethanol solution containing the copolymer, further stirred. The solution was transferred to a dish and the ethanol evaporated at room temperature over 8h to produce a transparent membrane. The membrane was cured at 100°C for 24 h in air for further thermo polymerization and the product was carbonized at 800°C. The characterization was carried out using SEM (Fig. 1), TEM (Fig. 2), SAXS and N₂ adsorption-desorption method (Fig. 3). The N₂ adsorption-desorption shows a type IV hysteresis with clear desorption curve; the structure is highly ordered with narrow space distribution, as indicated by capillary condensation step in the isotherm. SEM images indicates micro-sized rope-like fiber bundle morphology. TEM images shows cubic arrays of structured carbon.

![Fig. 1: N₂ adsorption-desorption isotherms of mesoporous carbons [1].](image-url)
2.2. Mesoporous TiO$_2$

TiO$_2$ has been widely studied as an effective catalyst because of its confined porous structure and high surface area to volume ratio and should also in principle have high photo-catalytic activity [3-4]. Various approaches to the synthesis of mesoporous TiO$_2$ with special morphology have been studied.

One such method is the synthesis of well-defined spherical mesoporous TiO$_2$ with a specific mono-disperse size using a “sol-gel” process [5]. It is prepared using a mixture of a titanium precursor and a tri-block copolymer surfactant in aqueous solution. A known amount of the tri-block copolymer surfactant Poly (ethylene glycol) – poly (propylene glycol)-poly (ethylene glycol) was dissolved in a known amount of distilled water. After the surfactant had dissolved sufficiently, a known amount of sulphuric acid was added. Titanium (IV) isopropoxide was mixed with 2,4-pentanedione in a separate beaker and dropped slowly into each surfactant solution with vigorous stirring. Reaction was carried out at 55$^\circ$C. Light yellow powder was obtained which was aged at 90$^\circ$C for 10 h. Resulting powders were filtered and thoroughly washed with water and alcohol and to eliminate the residual surfactant, powders were calcined at 400$^\circ$C.

Another modified approach to the above mentioned method is the synthesis of crack-free Mesoporous titania on a macroporous support without intermediate layers by “nano-particle modified polymeric sol-gel process” [6]. TiO$_2$ sol was synthesised via polymeric route where Ti(OC$_3$H$_7$)$_4$ and acetylacetone (acac) was added to the solution of L64 (pluronic di-functional block copolymer) in C$_6$H$_5$OH, HNO$_3$ and water was added drop wise to the solution to obtain a stable and transparent sol. The molar ratio of Ti(OC$_3$H$_7$)$_4$:L64:acac:C$_6$H$_5$OH:HNO$_3$:H$_2$O was 1:0.06:1:9:0:1:3. TiO$_2$ nanoparticle (Degussa P25) was added to the sol and dispersed by stirring. Tubular ZrO$_2$ support membranes were prepared by dip coating the fresh sol on support via a circulation process. P25 was well dispersed in the sol by ultrasonification during the coating. The coated films were dried and aged for
12 h and calcined in air at 400°C for 4 h. Tubular anatox TiO₂ ultrafiltration membranes of mesoporous pore size were obtained. Characterization of the TiO₂ membranes carried out using N₂ adsorption-desorption method (Fig. 4) and SEM (Fig. 5, 6). N₂ adsorption-desorption for different concentrations of P25, it showed type IV isotherm, which is an indication of well-defined pore structure. SEM images of TiO₂ showed cracks on the surface, but when P25 was used the surface was void of cracks. The cross-sectional view indicates a TiO₂ layer which is 2 microns thick, above the support.

Fig. 4: N₂ adsorption-desorption isotherm for TiO₂ with different concentration of P25 at 400°C [6].

Fig. 5: SEM image of TiO₂ material without P25 and with P25 [6].

Fig. 6: SEM image of cross-section of P-TiO₂ membrane [6].
2.3. Mesoporous Alumina

These have highly uniform channels, large surface area and highly ordered arrangement of particles. The common templates used for structure directing agents are anionic, cationic and non-ionic in nature. One of the notable methods of preparation is “Triton-100 directed synthesis of Mesoporous γ-Alumina from coal-series Kaolin” [7], where meta kaolin is leached with 6 M HCl; the leachate collected as the aluminium source to which NaOH is added to transform AlCl₃ to NaAlO₂. Further, addition 6 M HCl to the above solution precipitates Boehmite, which is used the precursor. The molar ratio of Al³⁺:TX-100:H₂O is 1:0.03-0.15:52. The solution was treated, washed with distilled water and dried. This was then calcined at 550°C to remove TX-100. Upon calcinations the hydroxyl (Al-OH) could be transformed to O-X-O (Al-O-Al bridges). The best Mesoporous structure is obtained when the molar fraction of TX-100 added is 0.12. The alumina thus formed has potential applications in adsorption and catalytic properties.

Another method of producing “thermally stable Mesoporous alumina using bayberry tannin (BT) as the template” [8] and aluminium nitrate as the precursor. Aluminium nitrate solution (0.8 mol/l) and BT solution (3 wt. %) was mixed and the pH was maintained at 5.5 using Ammonia solution. The obtained suspension was heated in an autoclave at 150°C under the N₂ atmosphere. The solution filtered, washed with distilled water, dried and calcined in aerobic atmosphere to remove bayberry tannin. The calcination was carried out in the temperature range of 700°C to 900°C; even on increasing the temperature to 900°C, the product obtained was stable. It is used for shape selective catalysis (Hydrogenation reaction). The TEM images of the catalyst is shown in Fig. 7. The Pd particles are 7.2 nm and 7.5 nm respectively in the Pd-Alumina prepared and reference. Pd is well dispersed in both the structures. The prepared structure is more active than reference, due to difference in the texture.

![Fig. 7: TEM image of (a) Pd-Alumina (prepared) and (b) Pd-Alumina (reference)](image)

2.4. Mesoporous Silica

Mesoporous silicas are a class of inorganic materials, which possess interesting properties such as stable Mesoporous structure, large surface areas, high pore volumes, well-ordered pore structures, and narrow pore-size distributions with relatively large-pore diameters (2–50 nm). Silicas have no inherent catalytic property but can be used as supports functionalized either by framework substitution or by post-synthesis surface modification. “Synthesis and characterization of periodic Mesoporous organosilicas with uniform spherical
"core-shell" [9] was carried out using stationary phase as the core. Silica core was synthesized using “Stober” method. Non-porous silica spheres were activated with 10% HCl followed by reflux. Addition of ammonia solution was done to maintain basic condition.

Stirring was carried followed by addition of CTAB, PEO-PPO-PEO, ethanol and distilled water solution to silica sol. The dispersion was filtered and newly formed particles served as starting seed particles for the next stage. Characterization for morphological study of core-shell particles was carried out using FTIR, SEM, N\textsubscript{2} adsorption-desorption method and the chromatographic evaluation done by HPLC. This material showed high column efficiency for fast separation of aromatic hydrocarbon. Another prominent application of Mesoporous silica is “Preparation of highly dispersed tungsten species within mesoporous silica by ionic liquid” [10]. Preparation of W-mesoporous silicas was carried out in the following manner: $\text{T}_8\text{W}_2\text{O}_{11}$ was dissolved in ethanol and followed by addition of distilled water. Tetraethylorthosilicate (TEOS) was added drop wise, the pH was adjusted between 9 and 10; solid products obtained were calcined at various temperatures (350, 450, 550, 650, 750, 850°C). The product thus obtained was used as a desulfurizing agent for diesel. Fig. 8 shows the High Resolution TEM (HRTEM) image. The dark spots indicates highly dispersed W species in Silica. The pore structure is distorted and wormhole structure.

![Fig. 8: HRTEM image of tungsten on Silica [10].](image)

III CONCLUSION

Various methods of obtaining mesoporous particles in the laboratory scale have been discussed. Typical methods were the sol-gel approach and use of tri-block copolymers. In certain synthesis procedures, use of surfactants was evident. A unique method of using of obtaining Alumina mesoporous particles using bayberry tannin as template was also discussed. Characterization of the thus synthesised materials was done using analytical methods like SEM, TEM, FTIR etc. For certain materials like mesoporous silica, calcination played an important role in the formation of the ordered mesostructure.

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REFERENCES

FAILURE MODE EFFECTIVE ANALYSIS FOR REQUIREMENTS PHASE IN SMALL SOFTWARE FIRM

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ABSTRACT

Failure mode and effects analysis (FMEA) is a risk management technique. If implemented properly this can be a great addition to the best quality assurance processes to be followed, FMEA is mostly used by the upper management or stakeholders. In practice, the testers get little insights into this technique. In this paper we have carried out FMEA in software firm to identify potential effects of failure in Requirements Phase in SDLC.

Keywords: FMEA, Management, Quality Assurance & SDLC.

I INTRODUCTION

The FME(C)A is a design tool used to systematically analyze postulated component failures and identify the resultant effects on system operations. The analysis is sometimes characterized as consisting of two sub-analyses, the first being the failure modes and effects analysis (FMEA), and the second, the criticality analysis (CA). Successful development of an FMEA requires that the analyst include all significant failure modes for each contributing element or part in the system. FMEAs can be performed at the system, subsystem, assembly, subassembly or part level. The FMECA should be a living document during development of a hardware design. It should be scheduled and completed concurrently with the design. If completed in a timely manner, the FMECA can help guide design decisions. The usefulness of the FMECA as a design tool and in the decision-making process is dependent on the effectiveness and timeliness with which design problems are identified. Timeliness is probably the most important consideration. In the extreme case, the FMECA would be of little value to the design decision process if the analysis is performed after the hardware is built. While the FMECA identifies all part failure modes, its primary benefit is the early identification of all critical and catastrophic subsystem or system failure modes so they can be eliminated or minimized through design modification at the earliest point in the development effort; therefore, the FMECA should be performed at the system level as soon as preliminary design information is available and extended to the lower levels as the detail design progresses.
Remark: For more complete scenario modelling another type of Reliability analysis may be considered, for example fault tree analysis (FTA); a deductive (backward logic) failure analysis that may handle multiple failures within the item and/or external to the item including maintenance and logistics. It starts at higher functional / system level. An FTA may use the basic failure mode FMEA records or an effect summary as one of its inputs (the basic events). Interface hazard analysis, Human error analysis and others may be added for completion in scenario modelling.

II LITERATURE SURVEY

The advancement and proliferation of information technology has made it possible for specified functions of systems including safety-critical systems to be software driven. Traditional failure analysis techniques existed before computers and are widely used in the failure analysis of hardware. Typically, hardware failures are random while software failures are systematic and this makes software failure analysis difficult to be addressed. However, similar approaches used in hardware failure analysis can be applied in the failure analysis of software at its architecture level. Such analysis informs design modifications in software and likely hardware to mitigating design weaknesses [1]

Driver Assistance Systems like Adaptive Cruise Control (ACC) can help to prevent accidents by reducing the workload on the driver. ACC is an automotive feature that allows a vehicle's cruise control system to adapt the vehicle's speed to the traffic environment. A radar system attached to the front of the vehicle is used to detect whether slower moving vehicles are in the ACC vehicle's path. If a slower moving vehicle is detected, the ACC system will slow the vehicle down and control the clearance, or time gap, between the ACC vehicle and the forward vehicle. If the system detects that the forward vehicle is no longer in the ACC vehicle's path, the ACC system will accelerate the vehicle back to its set cruise control speed. This operation allows the ACC vehicle to autonomously slow down and speed up with traffic without intervention from the driver. The purpose of this paper is to describe Failure Modes and Effects Analysis (FMEA) and fault tree analysis (FTA) based safety-critical approach towards to development of Adaptive Cruise Control system from a safety perspective [2]

Failure Mode and Effects Analysis (FMEA) is a methodology to find potential failures before they occur. While FMEA identifies individual failure modes, its primary benefit is the early identification of system failure modes so a solution can be designed to mitigate the potential failure. It is a methodology to design reliability into a system. In a FMEA, numerical weights can be applied to the likelihoods of each failure, as well as the severity of the consequences. FMEA is a very cost-effective, easy to learn, and productive way to design a more reliable system. Although this method was not originally created for software systems, we can translate the principles over to software and take advantage of the many benefits that FMEA has to offer. These benefits include:

• Facilitates early identification of failure points and system interface problems
• Yields a better understanding of planning/scheduling by revealing additional work efforts
The concept of software failure mode and effects analysis (FMEA) has grown in attractiveness over recent years as a way of assessing the reliability of software. Like its hardware counterpart, software FMEA is immensely tedious for an engineer to perform, as well as being error-prone.

The method provides results at a level where they can be understood and acted on by software engineers. A tool implementing this method has been applied to a travel expenses payment program, and some of the automatically produced results are presented. Such automation extends significantly the range of software for which software FMEA becomes a realistic proposition. The analysis is tractable, and has been shown to provide useful results for software engineers.

One important use of this analysis is to focus further testing. The software FMEA can be used to improve automated or source code embedded testing since tests can exonerate many potential faults allowing the FMEA analysis to present an engineer with a reduced set of potential faults. [4]

Conditions that lead to more severe failure effects in the presence of other anomalies (e.g. failures of monitoring software that normally causes no effect but very severe effects if the monitored function fails)
- Effects that can be overcome by automated or manual measures at the system level
- Failure modes for which the higher level effects and their severity must be assessed by Probabilistic methods (by convention, the entries for these reflect the most severe possibility)

It will have become apparent that the generation of the FMEA, even with the computer support, requires much insight into the software and system design. It is a purpose and benefit of our approach that much less FMEA expertise is required, and that software designers and system engineers can therefore assume a more active role in FMEA generation. [5]

Failure Mode and Effect Analysis (FMEA) was first developed as a formal design methodology in the 1960s by the aerospace industry with their obvious reliability and safety requirements. FMEA is a systematic method of identifying and preventing system, product and process problems before they occur. It is focused on preventing problems, enhancing safety and increasing customer satisfaction. Ideally FMEA’s are conducted in the product design or process development stages, although conducting an FMEA on Existing products or processes may also yield benefits. FMEA is a tool that allows us to prevent System, Product and Process problems before they occur. It reduces costs by identifying system, product and process improvements early in the development cycle. It prioritizes actions that decrease risk of failure.

**FMEA analyses**

1. Potential failure modes of product or machine,
2. Potential effects of failure,
3. Potential causes for failure (like Material defects, Design deficiencies, Processing and manufacturing deficiencies, and Service condition etc.)
4. Assesses current process controls, and
5. Determines a risk priority factor

One of the most powerful methods available for measuring the reliability of products or process is FMEA. Customers are placing increased demands on companies for high quality, reliable products. The increasing capabilities and functionality of many products are making it more difficult for manufacturers to maintain the quality and reliability. [6]

Failure Modes and Effects Analysis (FMEA) and Failure Modes, Effects and Criticality Analysis (FMECA) are methodologies designed to identify potential failure modes for a product or process before the problems occur, to assess the risk. Ideally, FMEA’s are conducted in the product design or process development stages, although conducting an FMEA on existing products or processes may also yield benefits.

The FMEA team determines, by failure mode analysis, the effect of each failure and identifies single failure points that are crucial. It may also rank each failure according to the criticality of a failure effect and its probability of occurring. The FMECA is the result of two steps:

- Failure Mode and Effect Analysis (FMEA)
- Criticality Analysis (CA). [7]

### III FMEA FOR REQUIREMENTS COLLECTION PHASE

<table>
<thead>
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<th>Failure Mode and Effects Analysis</th>
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<th>Process Function</th>
<th>Potential Failure Mode</th>
<th>Potential Effect of Failure</th>
<th>Probability</th>
<th>Severity</th>
<th>Criticality</th>
<th>Risk Priority</th>
<th>Recommended Action(s)</th>
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<td>Poor Requirements</td>
<td>Death and Destruction of Project</td>
<td>9</td>
<td>Lack of Communication</td>
<td>Not Specified</td>
<td>6</td>
<td>375</td>
<td>183</td>
<td>Training of Requirements Evaluation</td>
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<td>Unreliable and unstable systems</td>
<td>5</td>
<td>Lack of Architectural Knowledge</td>
<td>Not Specified</td>
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<td>Qualifications and Experience</td>
<td>Not Specified</td>
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<td>225</td>
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<td></td>
<td>Requirements not Trusted</td>
<td>Empty Documentation</td>
<td>8</td>
<td>No Proper Documentation</td>
<td>Not Specified</td>
<td>5</td>
<td>310</td>
<td>1550</td>
<td>Evaluate the requirements verification method</td>
</tr>
<tr>
<td></td>
<td>Meeting Requirements</td>
<td>Major SystemFailures</td>
<td>8</td>
<td>No Proper Documentation and Communication</td>
<td>Not Specified</td>
<td>4</td>
<td>180</td>
<td>720</td>
<td>Use Modern Methods like state modelling to be adopted</td>
</tr>
<tr>
<td></td>
<td>Exceed Requirements Volatility</td>
<td>Over Budget</td>
<td>6</td>
<td>Long Development Cycles</td>
<td>Not Specified</td>
<td>4</td>
<td>183</td>
<td>723</td>
<td>Use Modern Methods like state modelling to be adopted</td>
</tr>
<tr>
<td></td>
<td>Inadequate verification of Requirements Quality</td>
<td>Excessive WIP</td>
<td>6</td>
<td>Improper Planning</td>
<td>Not Specified</td>
<td>3</td>
<td>50</td>
<td>150</td>
<td>Use checklists</td>
</tr>
</tbody>
</table>

**Figure 1: FMEA Worksheet of Requirements Phase**
Figure 2: Risk Priority Number of Potential Effects of Failure in Requirements Phase

Figure 3: Risk Priority Percentage of Potential Effects of Failure in Requirements Phase
IV CONCLUSION

Figure 4: Scatter Plot for Risk Priority Percentage of Potential Effects of Failure in Requirements Phase

1. It has been observed that because of Poor requirements 29% of Projects have been affected.
2. Inappropriate contents and Requirements Untraceable accounts to 35% of Problems.
3. Excess Requirements Volatility and Missing Requirements constitute 25% of Problems.

Poor requirements quality is currently the number one problem in requirements engineering, and solving it will go a long way towards improving software and system development. Requirements engineers, stakeholders with whom they must collaborate, and requirements evaluators (e.g., inspectors and reviewers) need to be properly trained in the characteristics of good requirements including examples of both good and bad requirements, and they need to be taught how to tell the difference between them. [9]

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RULE-MINER ALGORITHM: SHORTEST ROUTE JUDGING ALGORITHM USING ANT COLONY OPTIMIZATION

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ABSTRACT

This document is prepared to suggest an algorithm for more consistent rule discovery called Rule-Miner. Rule-Miner’s goal is expected to extract and classifying and cataloguing rules from data. This algorithm is developed with notion observed from behavior of real world colonies of ant. We have compared the Rule-Miner’s Performance against C4.5 algorithm on five domain data sets. The comparison results suggests the following outcomes, a) Rule-Miner shows more accuracy than C4.5 and b) Rule-Miner creates simple rules.

Keywords: Ant Colony Optimization, Data Set, Rule-Miner

I. OVERVIEW

In core, the cataloguing process contains a class for each rule as a class out of a set of predetermined classes, based on the values of few traits (called forecaster traits) for the case. From analysis, it is evidentially shown that the area of data mining is gaining lot of interest to show comprehensive and simple information to user. So that they can decide more effectively based on the information provided by the system.

Generally in data mining, the discovery of information is mentioned in IF THEN estimation as follows: IF <criteria> THEN <new rule>. The <criteria> section (precursor) of the new rule consist a analytical mixture of forecaster traits, in the shape of: term1 & term2 &.... Each term consist of three values <trait, worker, result>, such as <Relation = Father>. The <class> part (in THEN part) of the new rule Consist of the class expected for cases (records) whose forecaster traits obeys the <criteria> part of the new rule.

Based on our analysis, the usage of Ant Colony Algorithms as one of the way to classify new rules. There are closed areas in data mining with respect to methods for classification of rules. Essentially, data mining algorithm done by Ant colony optimization is different from procedure proposed in this document. There is few other proposals using Ant Colony Optimization which actually learns fuzzy control rules but it is not in the scope of data mining.

We hope the creation of Ant Colony algorithms for data mining is a significant research area due to the following reasons. An Ant Colony organization comprises dwarf workers (ants) that work together with one
another to complete an evolving, combined behavior for the organization as a whole, constructing a robust system proficient of judging quality solutions for issues in bigger search space.

II. ASSESSMENT RESULTS – 1

We have evaluated Rule-Miner across five public-domain data sets. The main characteristics of the data sets used in our experiment are summarized in Table 1. The first column of this table identifies the data set, whereas the other columns indicate, respectively, the number of cases, number of categorical traits, number of continuous traits, and number of classes of the data set.

As mentioned earlier, Rule-Miner discovers rules referring only to categorical traits. Therefore, continuous traits have to be discretized as a pre-processing step. This discretization was performed by the C4.5-Disc discretization algorithm. This algorithm simply uses the C4.5 algorithm for discretizing continuous traits.

<table>
<thead>
<tr>
<th>Data set</th>
<th>#cases</th>
<th>#categ. trait.</th>
<th>#contin. trait.</th>
<th>#classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung cancer (Chicago)</td>
<td>383</td>
<td>10</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Lung cancer (Dallas)</td>
<td>572</td>
<td>0</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Tic-tac-toe</td>
<td>847</td>
<td>10</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Dentistry</td>
<td>247</td>
<td>33</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>144</td>
<td>15</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 1: Data Sets Used in Our Experiments

We have evaluated the performance of Rule-Miner by comparing it with C4.5 (Quinlan, 1993), a well-known rule induction algorithm. Both algorithms were trained on data discretized by the C4.5-Disc algorithm, to make the comparison between Rule-Miner and C4.5 fair.

The comparison was carried out across two criteria, namely the predictive accuracy of the discovered rule sets and their simplicity, as discussed in the following.

Predictive accuracy was measured by a 10-fold cross-validation procedure (Weiss & Kulikowski, 1991). In essence, the data set is divided into 10 mutually exclusive and exhaustive partitions. Then a classification algorithm is run 10 times. Each time a different partition is used as the test set and the other 9 partitions are used as the training set. The results of the 10 runs (accuracy rate on the test set) are then averaged and reported as the accuracy rate of the discovered rule set.

III. ASSESSMENT RESULTS – 2

The results comparing the accuracy rate of Rule-Miner and C4.5 are reported in Table 2. The numbers after the “±” symbol are the standard deviations of the corresponding accuracy rates. As shown in this table, Rule-Miner discovered rules with a better accuracy rate than C4.5 in four data sets, namely Chicagolung cancer, Dallaslung...
cancer, Diarrhoea and Liver disease. In two data sets, Chicagolung cancer and Liver disease, the difference was quite small. In the other two data sets, Dallaslung cancer and Diarrhoea, the difference was more relevant. Note that although the difference of accuracy rate in Dallaslung cancer seems very small at first glance, this holds only for the absolute value of this difference. In reality the relative value of this difference can be considered relevant, since it represents a reduction of 20% in the error rate of C4.5. ((96.04 – 95.02)/(100 – 95.02) = 0.20)

On the other hand, C4.5 discovered rules with a better accuracy rate than Ant Miner in the other two data sets. In one data set, Dentistry, the difference was quite small, whereas in the Tic-tac-toe the difference was relatively large. (This result will be revisited later.) Overall one can conclude that Rule-Miner is competitive with C4.5 in terms of accuracy rate, but it should be noted that Rule-Miner’s accuracy rate has a larger standard deviation than C4.5’s one.

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Rule-Miner’s accuracy rate (%)</th>
<th>C4.5’s accuracy rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung cancer (Chicago)</td>
<td>76.53±11.88</td>
<td>73.34 ± 3.21</td>
</tr>
<tr>
<td>Lung cancer (Dallas)</td>
<td>96.04 ± 2.80</td>
<td>95.02 ± 0.31</td>
</tr>
<tr>
<td>Tic-tac-toe</td>
<td>73.04 ± 7.60</td>
<td>83.18 ± 1.71</td>
</tr>
<tr>
<td>Dentistry</td>
<td>86.55 ± 6.13</td>
<td>89.05 ± 0.62</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>90.00 ± 9.35</td>
<td>85.96 ± 1.07</td>
</tr>
<tr>
<td>Liver disease (Toronto)</td>
<td>59.67 ± 7.52</td>
<td>58.33 ± 0.72</td>
</tr>
</tbody>
</table>

Table 2: Accuracy Rate of Rule-Miner vs. C4.5

We now turn to the results concerning the simplicity of the discovered rule set. This simplicity was measured, as usual in the literature, by the number of discovered rules and the total number of terms (criteria’s) in the antecedents of all discovered rules.

The results comparing the simplicity of the rule set discovered by Rule-Miner and by C4.5 are reported in Table 3. Again, the numbers after the “±” symbol denote standard deviations. As shown in this table, in five data sets the rule set discovered by Rule-Miner was simpler – i.e. it had a smaller number of rules and terms – than the rule set discovered by C4.5. In one data set, Chicagolung cancer, the number of rules discovered by C4.5 was somewhat smaller than the rules discovered by Ant Miner, but the rules discovered by Rule-Miner was simpler (shorter) than the C4.5 rules. To simplify the analysis of the table, let us focus on the number of rules only, since the results for the number of terms are roughly analogous. In three data sets the difference between the number of rules discovered by Rule-Miner and C4.5 is quite large, as follows.

In the Tic-tac-toe and Dentistry data sets Rule-Miner discovered 8.5 and 7.0 rules, respectively, whereas C4.5 discovered 83 and 23.2 rules, respectively. In both data sets C4.5 achieved a better accuracy rate. So, in these two data sets Rule-Miner sacrificed accuracy rate to improve rule set simplicity.
This seems a reasonable trade-off, since in many data mining applications the simplicity of a rule set tends to be even more important than its accuracy rate. Actually, there are several rule induction algorithms that were explicitly designed to improve rule set simplicity, even at the expense of reducing accuracy rate (Bohanec & Bratko, 1994; Brewlow & Aha, 1997; Catlett, 1991).

In the Liver disease data set Rule-Miner discovered 9.5 rules, whereas C4.5 discovered 49 rules. In this case the greater simplicity of the rule set discovered by Rule-Miner was achieved without unduly sacrificing accuracy rate – both algorithms have similar accuracy rates, as can be seen in the last row of Table 1.

There is, however, a caveat in the interpretation of the results of Table 3. The rules discovered by Rule-Miner are organized into an ordered rule list.

<table>
<thead>
<tr>
<th>Data set</th>
<th>No. of rules</th>
<th>No. of terms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rule-Miner</td>
<td>C4.5</td>
</tr>
<tr>
<td>lung cancer (Chicago)</td>
<td>7.20 ± 0.60</td>
<td>6.2 ± 4.20</td>
</tr>
<tr>
<td>lung cancer (Dallas)</td>
<td>6.20 ± 0.75</td>
<td>11.1 ± 1.45</td>
</tr>
<tr>
<td>Tic-tac-toe</td>
<td>8.50 ± 1.86</td>
<td>83.0 ± 14.1</td>
</tr>
<tr>
<td>Dentistry</td>
<td>7.00 ± 0.00</td>
<td>23.2 ± 1.99</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>3.40 ± 0.49</td>
<td>4.40 ± 0.93</td>
</tr>
<tr>
<td>Liver disease (Toronto)</td>
<td>9.50 ± 0.92</td>
<td>49.0 ± 9.4</td>
</tr>
</tbody>
</table>

Table 3: Simplicity of Rule Sets Discovered by Rule-Miner vs. C4.5

This means that, in order for a rule to be applied to a test case, the previous rules in the list must not cover that case. As a result, the rules discovered by Rule-Miner are not as modular and independent as the rules discovered by C4.5. This has the effect of reducing a little the simplicity of the rules discovered by Rule-Miner, by comparison with the rules discovered by C4.5. In any case, this effect seems to be quite compensated by the fact that, overall, the size of the rule list discovered by Rule-Miner is much smaller than the size of the rule set discovered by C4.5. Therefore, it seems safe to say that, overall, the rules discovered by Rule-Miner are simpler than the rules discovered by C4.5, which is an important point in the context of data mining.

Taking into account both the accuracy rate and rule set simplicity criteria, the results of our experiments can be summarized as follows.

In three data sets, namely Dallas lung cancer, Diarrhoea and Liver disease, Rule-Miner discovered a rule set that is both simpler and more accurate than the rule set discovered by C4.5. In one data set, Chicago lung cancer, Rule-Miner was more accurate than C4.5, but the rule sets discovered by Rule-Miner and C4.5 have about the same level of simplicity. (C4.5 discovered fewer rules, but Rule-Miner discovered rules with a smaller number of terms.)

Finally, in two data sets, namely Tic-tac-toe and Dentistry, C4.5 achieved a better accuracy rate than Rule-Miner, but the rule set discovered by Rule-Miner was simpler than the one discovered by C4.5. It is also
important to notice that in all six data sets the total number of terms of the rules discovered by Rule-Miner was smaller than C4.5’s one, which is a strong evidence of the simplicity of the rules discovered by Rule-Miner.

IV. CONCLUSION

These results were obtained for a Pentium II PC with clock rate of 333 MHz and 128 MB of main memory. Rule-Miner was developed in C++ language and it took about the same processing time as C4.5 (on the order of seconds for each data set) to obtain the results. It is worthwhile to mention that the use of a high-performance programming language like C++, as well as an optimized code, is very important to improve the computational efficiency of Rule-Miner and data mining algorithms in general. The current C++ implementation of Rule-Miner is about three orders of magnitude (i.e., thousands of times) faster than a previous Mat Lab implementation.

REFERENCES

FINDING PACKET MODIFIERS IN WIRELESS NETWORK USING PACKET DROPPING RATIO

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ABSTRACT

In the recent days, wireless communication usage’s are huge and modern improvement’s as stipulate for wireless system goes on escalating to mount. Today’s, the majority traditional and emerging system in wireless Network is Mobile Ad hoc Network (MANET) as number of mobile consumers are goes on increasing day by day. MANET is the wireless network and it has no infrastructure (no centralized server to maintain the entire networks). So that it is appropriate in various and numerous pasture for communication networks such as used in many applications like military communications system, adroit planning operations, and environmental assault marks networks. In the MANET, geo-routing of mobile nodes necessitate to preserve and continue to up-to-date their respective and their immediate neighbors nodes positions in the networks for making effective forwarding of data packets. For the regular updating of the bonfire packets to the neighboring nodes we proposed the adaptive position update for mobile nodes. Packet dropping and modification are common attacks that can be launched by an adversary to disrupt communication in wireless multi hop sensor networks. Many schemes have been proposed to mitigate or tolerate such attacks, but very few can effectively and efficiently identify the intruders. To address this problem, we propose a simple yet effective scheme, which can identify misbehaving forwarders that drop or modify packets. Extensive analysis and simulations have been conducted to verify the effectiveness and efficiency of the scheme.

Keywords: Packet Dropping, Packet Modification, Intrusion Detection, Wireless Sensor Networks.

I INTRODUCTION

In a wireless sensor network, sensor nodes monitor the environment, detect events of interest, produce data, and collaborate in forwarding the data toward a sink, which could be a gateway, base station, storage node, or querying user. Because of the ease of deployment, the low cost of sensor nodes and the capability of self-organization, a sensor network is often deployed in an unattended and hostile environment to perform the monitoring and data collection tasks. When it is deployed in such an environment, it lacks physical protection and is subject to node compromise. After compromising one or multiple sensor nodes, an adversary may launch various attacks [1] to disrupt the in-network communication. Among these attacks, two common ones are dropping packets and modifying
packets, i.e., compromised nodes drop or modify the packets that they are supposed to forward. To deal with packet droppers, a widely adopted countermeasure is multipath forwarding [2], [3], [4], [5], in which each packet is forwarded along multiple redundant paths and hence packet dropping in some but not all of these paths can be tolerated. To deal with packet modifiers, most of existing countermeasures [6], [7], [8], [9] aim to filter modified messages en-route within a certain number of hops. These countermeasures can tolerate or mitigate the packet dropping and modification attacks, but the intruders are still there and can continue attacking the network without being caught.

In this paper, we propose a simple yet effective scheme to catch both packet droppers and modifiers. In this scheme, a routing tree rooted at the sink is first established. When sensor data are transmitted along the tree structure toward the sink, each packet sender or forwarder adds a small number of extra bits, which is called packet marks, to the packet. The format of the small packet marks is deliberately designed such that the sink can obtain very useful information from the marks. Specifically, based on the packet marks, the sink can figure out the dropping ratio associated with every sensor node, and then runs our proposed node categorization algorithm to identify nodes that are droppers/modifiers for sure or are suspicious droppers/ modifiers. As the tree structure dynamically changes every time interval, behaviors of sensor nodes can be observed in a large variety of scenarios. As the information of node behaviors has been accumulated, the sink periodically runs our proposed heuristic ranking algorithms to identify most likely bad nodes from suspiciously bad nodes. This way, most of the bad nodes can be gradually identified with small false positive. Our proposed scheme has the following features:

1) Being effective in identifying both packet droppers and modifiers,
2) Low communication and energy overheads, and
3) Being compatible with existing false packet filtering schemes;

That is, it can be deployed together with the false packet filtering schemes, and therefore it can not only identify intruders but also filter modified packets immediately after the modification is detected. Extensive simulation on ns-2 simulator has been conducted to verify the effectiveness and efficiency of the proposed scheme in various scenarios.

II SECURITY ASSUMPTIONS AND ATTACK MODEL

We assume the network sink is trustworthy and free of compromise, and the adversary cannot successfully compromise regular sensor nodes during the short topology establishment phase after the network is deployed. This assumption has been widely made in existing work [8], [24]. After then, the regular sensor nodes can be compromised. Compromised nodes may or may not collude with each other. A compromised node can launch the following two attacks:
2.1 Packet dropping
A compromised node drops all or some of the packets that is supposed to forward. It may also drop the data generated by itself for some malicious purpose such as framing innocent nodes.

2.2 Packet Modification
A compromised node modifies all or some of the packets that is supposed to forward. It may also modify the data it generates to protect itself from being identified or to accuse other nodes.

III THE PROPOSED SCHEME
Our proposed scheme consists of a system initialization phase and several equal-duration rounds of intruder identification phases. In the initialization phase, sensor nodes form a topology which is a directed acyclic graph (DAG). A routing tree is extracted from the DAG. Data reports follow the routing tree structure. In each round, data are transferred through the routing tree to the sink. Each packet sender forwarder adds a small number of extra bits to the packet and also encrypts the packet. When one round finishes, based on the extra bits carried in the received packets, the sink runs a node categorization algorithm to identify nodes that must be bad. Packet Transmission. When a node wants to send out a packet, it attaches to the packet a sequence number, encrypts the packet only with the key shared with the sink, and then forwards the packet to its parent on the routing tree. When an innocent intermediate node receives a packet, it attaches a few bits to the packet to mark the forwarding path of the packet, encrypts the packet, and then forwards the packet to its parent. On the contrary, a misbehaving intermediate node may drop a packet it receives. On receiving a packet, the sink decrypts it, and thus finds out the original sender and the packet sequence number. The sink tracks the sequence numbers of received packets for every node, and for every certain time interval, which we call a round, it calculates the packet dropping ratio for every node. Based on the dropping ratio and the knowledge of the topology, the sink identifies packet droppers based on rules we derive. In detail, the scheme includes the following components, which are elaborated in the following.

3.1 System Initialization
The purpose of system initialization is to set up secret pair wise keys between the sink and every regular sensor node, to establish the DAG and the routing tree to facilitate packet forwarding from every sensor node to the sink. Preloading keys and other system parameters. Each sensor node u is preloaded the following information:

- \(K_u\): a secret key exclusively shared between the node and the sink.
- \(L_r\): the duration of a round.
- \(N_p\): the maximum number of parent nodes that each node records during the DAG establishment procedure.
- \(N_s\): the maximum packet sequence number. For each sensor node, its first packet has sequence number 0, the \(N_i\) th packet is numbered \(N_{i-1}\), the \((N_i+1)\) th packet is numbered 0, and so on and so forth.
3.2 Packet Sending and Forwarding

Each node maintains a counter $C_p$ which keeps track of the number of packets that it has sent so far. When a sensor node $u$ has a data item $D$ to report, it composes and sends the following packet to its parent node $P_u$

$$(P_u, \{ R_u, C_p \bmod N_S, D, pad_{u,0} \} K_u, pad_{u,1})$$

Where $C_p \bmod N_S$ is the sequence number of the packet. $R_u$ ($0 \leq R_u \leq N_s - 1$) is a random number picked by node $u$ during the system initialization phase, and $R_u$ is attached to the packet to enable the sink to find out the path along which the packet is forwarded. $(X)_Y$ represents the result of encrypting $X$ using key $Y$. Paddings $pad_{u,0}$ and $pad_{u,1}$ are added to make all packets equal in length, such that forwarding nodes cannot tell packet sources based on packet length. Meanwhile, the sink can still decrypt the packet to find out the actual content. To satisfy these two objectives simultaneously, the paddings are constructed as follows:

- For a packet sent by a node which is $h$ hops away from the sink, the length of $pad_{u,1}$ is $\log(N_p) \cdot (h-1)$ bits. As to be described later, when a packet is forwarded for one hop, $\log(N_p)$ bits information will be added and meanwhile, $\log(N_p)$ bits will be chopped off.
- Let the maximum size of a packet be $L_p$ bits, a node ID be $L_id$ bits and data $D$ be $L_d$ bits. $pad_{u,0}$ should be $L_p - L_id \cdot 2 - \log(N_p) - h \cdot \log(N_u) - L_id$ bits, where $L_id$ is for $P_u$ and $u$ fields in the packet, field $R_u$ is $\log(N_p)$ bits long, field $pad_{u,1}$ is $\log(N_p) \cdot (h-1)$ bits long, and $C_p \bmod N_S$ is $\log(N_p)$ bits long. Setting $pad_{u,0}$ to this value ensures that all packets in the network have the same length $L_p$.

When a sensor node $v$ receives packet $(v, m)$ it composes and forwards the following packet to its parent node $P_v(P_v, \{ R_v, m' \} K_v)$, where $m'$ is obtained by trimming the rightmost $\log(N_p)$ bits off $m$. Meanwhile, $R_v$, which has $\log(N_p)$ bits, is added to the front of $m$. Hence, the size of the packet remains unchanged. Suppose on a routing tree, node $u$ is the parent of node $v$ and $v$ is a parent of node $w$. When $u$ receives a packet from $v$, it cannot differentiate whether the packet is originally sent by $v$ or $w$ unless nodes $u$ and $v$ collude. Hence, the above packet sending and forwarding scheme results in the difficulty to launch selective dropping, which is leveraged in locating packet droppers. We take special consideration for the collusion scenarios, which are to be elaborated later.

3.3 Packet Receiving at the Sink

We use node 0 to denote the sink. When the sink receives a packet $(0, m')$, it conducts the following steps:

1. Initialization. Two temporary variables $u$ and $m$ are introduced. Let $u=0$ and $m=m'$ initially.
2. The sink attempts to find out a child of node $u$, denoted as $v$, such that $\text{dec}(K_v, m)$ results in a string starting with $R_v$, where $\text{dec}(k, m)$ means the result of decrypting $m$ with key $K_v$.
3. If the attempt fails for all children nodes of node $u$, the packet is identified as having been modified and thus should be dropped.
4. If the attempt succeeds, it indicates that the packet was forwarded from node \( v \) to node \( u \). Now, there are two cases:

**Algorithm 1. Packet Receipt at the Sink**

step 1: Input: packet \((0, m)\).
step 2: \( u = 0, m' = m \);
step 3: \( \text{hasSuccAttempt} = \text{false} \);
step 4: for each child node \( v \) of node \( u \) do
step 5: \( P = \text{dec}(K_v, m') \);
step 6: if decryption fails then
step 7: continue;
step 8: else
step 9: \( \text{hasSuccAttempt} = \text{true} \);
step 10: if \( P \) starts with \((R_v, v)\) then
step 11: record the sequence number;
step 12: break;
step 13: else
step 14: trim \( R_v \) from \( P \) and get \( m' \);
step 15: \( u < v, \text{hasSuccAttempt} = \text{false}; \) go to step 4;
step 16: if \( \text{hasSuccAttempt} = \text{false} \) then
step 17: drop this packet;

**IV TREE REŠAPING AND RANKING ALGORITHMS**

The tree used to forward data is dynamically changed from round to round, which enables the sink to observe the behavior of every sensor node in a large variety of routing topologies. For each of these scenarios, node categorization algorithm is applied to identify sensor nodes that are bad for sure or suspiciously bad. After multiple rounds, sink further identifies bad nodes from those that are suspiciously bad by applying several proposed heuristic methods.

**4.1 Tree Reshapıng**

The tree used for forwarding data from sensor nodes to the sink is dynamically changed from round to round. In other words, each sensor node may have a different parent node from round to round. To let the sink and the nodes have a consistent view of their parent nodes, the tree is reshaped as follows. Suppose each sensor node \( u \) is preloaded with a hash function \( h(.) \) and a secret number \( K_u \) which is exclusively shared with the sink. At the beginning of each round \( i(i=1,2,\ldots) \), node \( u \) picks the \([h^i(K_u) \text{MOD } n_{p,u}]\) th parent node as its parent node for this round, where \( h(K_u) = h(h^{i-1}(K_u)) \) and \( n_{p,u} \) is the number of candidate parent nodes that node \( u \) recorded during the
tree establishment phase. Recall that node \( u' \) candidate parent nodes are those which are one hop closer to the sink and within node \( u' \) communication range. Therefore, if node \( u \) choose node \( w \) as its parent in a round, node \( w \) will not select node \( u \) as its parent, and the routing loop will not occur. Note that, how the parents are selected is predetermined by both the preloaded secret \( K_u \) and the list of parents recorded in the tree establishment phase. The selection is implicitly agreed between each node and the sink. Therefore, a misbehaving node cannot arbitrarily select its parent in favor of its attacks.

### 4.2 Identifying Most Likely Bad Nodes from Suspiciously Bad Nodes

We rank the suspiciously bad nodes based on their probabilities of being bad, and identify part of them as most likely bad nodes. Specifically, after a round ends, the sink calculates the dropping ratio of each node, and runs the node categorization algorithm to identify nodes that are bad for sure or suspiciously bad. Since the number of suspiciously bad nodes is potentially large, we propose how to identify most likely bad nodes from the suspiciously bad nodes as follows. By examining the rules in Cases 3 and 4 for identifying suspiciously bad nodes, we can observe that in each of these cases, there are two nodes having the same probability to be bad and at least one of them must be bad. We call these two nodes as a suspicious pair. For each round \( i \), all identified suspicious pairs are recorded in a suspicious set denoted as

\[
S_i = \{ (u_j, v_j) \mid (u_j, v_j) \text{ is a suspicious pair and } u_j, v_j = v_j, u_j \}.
\]

**Algorithm 2. The Global Ranking-Based Approach**

1. Sort all suspicious nodes into queue \( Q \) according to the descending order of their accused account values
2. \( S \leftarrow \emptyset \)
3. While \( \bigcup_{i=1}^{n} S_i \neq \emptyset \) do
4. \( S \leftarrow S \setminus \{ u \} \)
5. Remove all \((u,*)\) from \( \bigcup_{i=1}^{n} S_i \)

Step wise ranking-based (SR) method. It can be anticipated that the GR method will falsely accuse innocent nodes that have frequently been parents or children of bad nodes: as parents or children of bad nodes, according to previously described rules in Cases 3 and 4, the innocents can often be classified as suspiciously bad nodes. To reduce false accusation, we propose the SR method. With the SR method, the node with the highest accused account value is still identified as a most likely bad node. However, once a bad node \( u \) is identified, for any other node \( v \) that has been suspected together with node \( u \), the value of node \( v' \) accused account is reduced by the times that \( u \) and \( v \) have been suspected together. This adjustment is motivated by the possibility that \( v \) has been framed by node \( u \). After the adjustment, the node that has the highest value of accused account among the rest nodes is identified as the
next mostly like bad node, which is followed by the adjustment of the accused account values for the nodes that have been suspected together with the node. Note that, similar to the GR method, after a node u is identified as bad, all suspicious pairs with format (u,*) are removed from S1,…Sn.

4.3 Handling Collusion

Because of the deliberate hop by hop packet padding and encryption, the packets are not distinguishable to the upstream compromised nodes as long as they have been forwarded by an innocent node. The capability of launching collusion attacks is thus limited by the scheme. However, compromised nodes that are located close with each other may collude to render the sink to accuse some innocent nodes. We discuss the possible collusion scenarios in this section and propose strategies to mitigate the effects of collusion.

**Fig.1: Collusion Scenarios.**

**BLOCK DIAGRAM**
Horizontal collusion. If nodes B, C, and D are compromised and collude, they will drop all or some of the packets of their own and their downstream nodes. Consequently, according to the rules in Case 3, (A, B), (A, C), and (A, D) are all identified as pairs of suspiciously bad nodes. Since A has been suspected for more times than B, C, and D, it is likely that A is falsely identified as bad node.

Vertical collusion. If nodes B and E are compromised and collude, B may drop some packets of itself and its downstream nodes, and then E further drops packets from its downstream nodes including B and B’s downstream nodes. Note that, E cannot differentiate the packets forwarding/generating by B since they are encrypted by node A. Consequently, the dropping rates for B and its downstream nodes are higher than that for node A. According to Case 4, (E, A) and (A, B) are both identified as pairs of suspiciously bad nodes. Since A has been suspected for more times than B and E, it is likely to be identified as a bad node.

V CONCLUSION

We propose a simple scheme to identify misbehaving forwarders that drop or modify packets. Each packet is encrypted and padded so as to hide the source of the packet. The packet mark, a small number of extra bits, is added in each packet such that the sink can recover the source of the packet and then figure out the dropping ratio associated with every sensor node. The routing tree structure dynamically changes in each round so that behaviors of sensor nodes can be observed in a large variety of scenarios. Finally, most of the bad nodes can be identified by our heuristic ranking algorithms with small false positive. Extensive analysis, simulations, and implementation have been conducted and verified the effectiveness of the proposed scheme.

REFERENCES


A SINGLE DISK FAILURE RECOVERY FOR X-CODE BASED PARALLEL STORAGE SYSTEMS

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ABSTRACT

Achieving data availability and reliability guarantees against disk failure using redundancy coding scheme. X-code is a double tolerant to achieve the optimal update complexity. It reduces the possibility of data unavailability when disk/node fails. X-code based optimal recovery scheme Minimum-disk-read-recovery (MDRR) and Group-based MDRR (GMDRR) minimizes the number of disk reads for a single-disk failure recovery. A tight lower bound of disk read is formed and MDRR algorithm is applied to match the theoretical lower bound. A disk read cannot be balanced while matching the lower bound of disk reads within a single stripe and cannot be balanced among different disk by simply rotating disk. A leap rotation scheme which balances disk read among different disk within a group of stripes and it matches the lower bound of disk read is called as GMDRR. MDRR reduces around 25% percent of recovery time of the conventional approach.

Keywords: Distributed System, Data Availability, Recovery Algorithm

I. INTRODUCTION

A large parallel storage system is to make information reliable and available for a long period of time. To achieve reliability and availability in the face of component failures redundancy techniques have been widely used in parallel storage. RAID-6 array codes can be categorized into two classes. The first class is the horizontal codes, such as RDP and EVENODD, where original data fragments are stored in data disks while encoded fragments (known as parities) are stored in dedicated parity disks (also known as P and Q disks). Another class is vertical codes, such as X-code, where parities are distributed across all disks. When a disk failure occurs in a parallel storage system, it is important to recover the erased data in the failed disk as quickly as possible to maintain the system reliability guarantees.

A conventional approach is to download the entire file and reconstruct the original data, and then regenerate the data fragments of the failed disk. The conventional approach will cost a great deal of data transmission. The total amount of data that must be processed during recovery plays a crucial role in recovery time and affects the system service.
performance. This is particularly important in parallel storage systems, where network transmission bandwidth is a potential performance bottleneck.

II. RELATED WORK

The constructions of new MDS codes can achieve improved recovery performance. Hu et al. further consider cooperative recovery for multi-node failures. However, regenerating codes have yet to see practical deployment, possibly due to several constraints. Most regenerating codes require storage nodes be programmable to support the encoding capability for recovery, thereby limiting the deployable platforms for practical storage systems. Some regenerating codes can be implemented without the encoding capability of a storage node, but generally introduce higher storage overhead than traditional erasure codes. Their encoding operations involve linear computations on finite fields, and are more computationally expensive than XOR-based MDS array codes. An efficient recovery scheme called the Path Directed Recovery Scheme (PDRS), which can decrease the disk I/O complexity by up to 25 percent for all vertical RAID-6 codes like P-code and X-code when recovering a single failed disk. However, they do not formally derive the lower bound of disk reads. Also, PDRS cannot consider the load balancing problem among different disks during recovery. Its performance decreases greatly as the size of storage system increases as their experiments indicated.

III. PROPOSED SYSTEM

The core objectives of the proposed system is to recover a single disk failure for parallel storage systems using a well-known MDS array code called X-code, which can tolerate double disk failures. X-code is optimal in computational complexity, update complexity, and space efficiency among all the RAID-6 codes. Unlike RDP and EVENODD codes, both of which are horizontal codes, X-code is a vertical code that has a different geometrical structure where parities are placed in rows rather than columns. Thus, X-code has an advantage of achieving load balancing for data updates within a stripe among different disks, instead of aggregating parities in dedicated parity disks as in RDP and EVENODD codes. Due to the different geometrical structure, the recovery algorithms previously proposed for RDP and EVENODD codes are no longer applicable for X-code.

The process of Fault Tolerance and Recovery process is done by MDRR and GMDRR Algorithm. MDRR does not possess the disk read balancing property, i.e., it reads different number of symbols from different disks. In case of unbalanced disk read, a disk with a heavier load will slow down the recovery and degrade the availability of the system. Here, we prove that disk read cannot be balanced in a stripe while matching the lower bound in general cases. Furthermore, it cannot be balanced by disk rotation. We then present a method which balances disk read in a group of \( p-1 \) stripes while matching the lower bound. MDRR (Minimum Disk Read Recovery) algorithm will extract the \( n \)-number of disk node and evaluate the availability of disk. The availability of disk is valid, the generate parity strip will be submitted otherwise search other disk node. In GMDRR creates group of parity rows of specific disk node. The generated group of rows is split by the EVENODD Row Algorithm. The separated group EVEN or
ODD rows will transfer valid disk arrays. The GMDRR and EVENODD Algorithm will be used for recovery for the failed strip of valid disk.

![System Diagram](image)

**Figure 1: System Diagram**

**IV. RESULTS AND DISCUSSIONS**

The process of sensitive data management and storing it in n-number of disk by credit card based business application. Five nodes are taken and the business application is created. The business application having following process,

a. Account Request
b. Activation
c. User Transaction
d. Company Service
   i. Disk Parity Service
   ii. Recovery Console

Account Request form is managing the new customer account service and activation is used activate user requested account, providing unique ID for business transaction. The account activated customer start business transaction and submits sensitive data to server. Each and every transaction rows are transferred n-number of storage disk. If any fault occurs for data storage, RAID Technique is applied and transfers the user sensitive to available storage.
node. The company module is used to manage the disk parity service to count the rows and replace the other storage with the help MDRR and GMDRR Algorithm.

**BUSINESS APPLICATION**

Bank application is created to explain the disk/node failure. This module consists of user transaction, administrator maintains the user account and their transaction. Row parity is maintained by the transaction log.

**ACCOUNT REQUEST FORM**
User opens an account in the bank by providing their personal information. Bank automatically generates the account number for user.

**ADMINISTRATOR LOGIN FORM**

![Login Form](image1)

![Account Details](image2)
Administrator activate the user account, maintain the transaction made in each disk and provides the node transformation information.

**CARD ACTIVATION**

![Image of Card Activation Service]

**CUSTOMER TRANSACTION**

![Image of Customer Transaction]

**Indian Bank**

Welcome to Customer Payment Center

- Account Number: 10420400049
- Customer ID: SASI
- Receiver Number: 104200000
- Amount: 10000

Click to Pay
Transaction is made by the user by specifying the receiver account number and the amount. User transaction is viewed in each disk using this module. Disk2 and Disk3 is failed. So the status of the disk 2 and disk 3 is denoted as 0.

**TRANSACTION DETAILS**
The detail of each disk is specified in this module i.e no of transaction made in each disk. Disk2 has failed in last two transaction and disk3 has failed in last 3 transaction. We can retrieve the data of Disk2 and Disk3 when it is available in network.

**ROW PARITY GROUPING**

Disk2 have been retrieved by the last two data lost. We are grouping the disk which has a maximum element from the remaining disk.
V. CONCLUSION
Optimal recovery solutions are mainly designed for RAID-6 horizontal codes, this is the first work that addresses the optimal recovery problem of RAID-6 vertical codes. The principle of leap rotation is implementing data encoding based on logical number of disks, and this rotation scheme can be applied to balance disk reads in storage systems with different codes. The problem of existing techniques is finding the maximum of record count in all disk arrays and create group to identifying availability of record. The created group will be replaced with the help of MDRR and GMDRR algorithm. The process take long time to fill in rows of all disk. But our Dump techniques eliminate the above problem and reduce time interval for fill into rows at disk arrays.

REFERENCES
EFFECT OF TAPER AND TWISTED BLADE IN STEAM TURBINES

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ABSTRACT

Turbo machinery is critical to various processes and their application range from steam turbines to aircraft turbines. Turbo machinery bladed disks are subjected to severe centrifugal loads. The centrifugal force is one of the problems that face the designers of blades especially the long ones. The severe loading leads to large peak stresses. One way to tackle this is by using twisted blades or using variable cross-section area blades. Rotating structures having the shape of pre-twisted blades commonly affect the modal characteristics. In order to design the rotating structures properly, their modal characteristics must be estimated accurately. The modal characteristics of rotating structures often vary significantly due to the effect of the centrifugal inertia force induced by the rotation motion. For this reason, the modal characteristics of rotating structures have to be investigated. In this paper effect of taper and twist in steam turbine blade is analyzed using ANSYS. Blades are idealized as tapered cantilever beams that are fixed to a rotating disc. The results obtained are then utilized in the design of the constant stress blade.

Keywords: Centrifugal Inertia Force, Peak Stresses, Pre-Twisted Blades, Turbo Machinery

1. INTRODUCTION

Structural integrity of all rotating components is the key for successful operation of any turbo machinery. This integrity depends on the successful resistance of the machine parts to the steady and alternating stresses imposed on them. The challenge with rotating equipment, such as turbo machinery, is often more severe due to the significance of the alternating loads that must be carried to satisfy their purpose.

In the most of the application the rotor blades are tapered from hub to tip. This reduces the weight of the peripheral portions of the blade and hence the hub stress, which must be carried under the high rotational speeds, will be reduced [1]. The centre line of the blade section will be normally located on the radial line to avoid the bending stress in the blade. But in some cases the blades are bent forward in the direction of motion to permit centrifugal bending moment to offset the air/gas thrust moment.

The rotor blades of high aspect ratio are twisted from hub to tip to compensate for the blade velocity variations and also to satisfy the radial pressure equilibrium conditions. Blade vibrations have also been the cause for failure in many cases [2, 3]. Hence it is important that the natural frequencies of the blade be such that it is outside the operating frequency range of the turbine not coincides with the harmonic speeds.
The blade of variable cross section with thin aerofoil sections at and near the blade tip are relatively heavy sections near the blade root. Therefore, where the peripheral speed of the blade is high, the mass per unit length of blade is minimum and where the resultant centrifugal force is high, the blade section is maximum. This tends to a more uniform blade stress than would be obtained in a blade of constant cross section. In order to obtain an even more uniform centrifugal stress, the blade is often tapered in width. The cross sectional area of a tapered blade may be varied in such a way that, centrifugal stress is uniform over greatest part of blade length. Centroid of the various cross sections should, as far as possible, lie on a radial line so as to eliminate bending due to inertia forces. By setting the line of centroids, a little forward of the radial line, the bending moment due to centrifugal force may be utilized partially to counteract the moment due to impulse. Taper influences both bending and torsional vibrations due to the variation in mass and stiffness along the length of the blade. Uniform stepped beams of rectangular cross section can approximate tapered blade. It is seen that, a decrease in the cross sectional dimensions of breadth with constant thickness increases the fundamental bending frequency as well as higher mode bending frequencies while decrease in thickness with constant breadth increases, the fundamental bending frequency and decrease other higher modes[4].

II OBJECTIVES OF THE PRESENT WORK

- To study the effect of taper and twist in steam turbine rotating blade as structural integrity.
- To study the effect of blade pull and average stress from gross yielding point of view and tip rub due to blade growth.
- To study the effect of blade stiffening on frequency shift to achieve the required separate margin.
- Role of stress stiffening and Spin softening on blade frequency.

III DESIGN CONSIDERATIONS

The Normal operating speed of the machine is 8650RPM and the blade material selected is Chrome Steel (X28CrMoNiV49) having properties like Density, Young’s Modulus, Poisson’s ratio, Yield strength and Coefficient of thermal Expansion are 7.85E-9 Ton/mm$^3$, 210E3 N/mm$^2$, 0.3, 550 MPa and 11.7E-6/°C (At operating Temperature 100°C). The thickness of the blade=2mm.

IV STRUCTURAL AND MODAL ANALYSIS

Steam turbine blades are subjected to centrifugal loads from high rotational speeds apart from steam bending forces. The blades are subjected to excitation frequencies ranging from the rotational speed and its harmonics. There are other excitations depending on the number of nozzles or vanes in each respective stage together with their harmonics. Therefore, it is inevitable that some blades or other in the flow path are subjected to resonance near the operational speed. In any case all the blades are subjected to some form of resonance during start up or shut down operations and in some cases at speeds very close to operational speed. In such blades that may operate in near-resonant conditions close to the operating speed, the designers have to provide sufficient damping to give the desired life These blades are susceptible for failures, unless very close grid frequency control is maintained.[5-7]
4.1. Spin softening
The vibration of a spinning body will cause relative circumferential motions, which will change the direction of the centrifugal load which, in turn, will tend to destabilize the structure. As a small deflection analysis cannot directly account for changes in geometry, the effect can be accounted for by an adjustment of the stiffness matrix, called spin softening [8].

4.2. Stress Stiffening
Stress stiffening (also called geometric stiffening, incremental stiffening, initial stress stiffening [9], or differential stiffening by other authors) is the stiffening (or weakening) of a structure due to its stress state. This stiffening effect normally needs to be considered for thin structures with bending stiffness very small compared to axial stiffness, such as cables, thin beams, and shells and couples the in-plane and transverse displacements.

4.3. Methodology of Prestress Modal Analysis
Pre stress modal analysis option is used to calculate the modes of a prestressed structure. By default, no prestress effects are included, i.e., the structure is assumed to be stress free.

4.4. Effect of Rotation
The turbine blade gets stiffened in bending because of centrifugal forces and thus, the bending natural frequencies increase the speed of rotation. There is no effect of centrifugal forces in torsional motion of the blade. The first consequence of centrifugal force is to influence the geometric form of blade. Those blades which are heavily twisted or which have non-symmetric cross sections are liable to change in their geometric form under running conditions.

4.5. Methodology of Stress stiffening-Increase stiffness
Stress stiffening, also called geometric stiffening or initial stress stiffening. Stress stiffening is the stiffening (or weakening) of a structure due to its stress state. This stiffening effect normally needs to be considered for thin structures with bending stiffness very small compared to axial stiffness.

4.6. Methodology of Spin softening: Linear effect-reduces stiffness
Adjustment of stiffness to account for the changes in geometry due to centrifugal effects. The vibration of a spinning body will cause relative circumferential motions, which will change the direction of the centrifugal load which, in turn, will tend to destabilize the structure. As a small deflection analysis cannot directly account for changes in geometry, the effect can be accounted for by an adjustment of the stiffness matrix, called spin softening. The meshed model and the Vonmises stress plot of straight, tapered and Taper & Twisted is as shown in Fig.1
V RESULTS AND DISCUSSIONS

It is observed that at a rated speed of 8550rpm so much of 62.645N/mm$^2$ of stress is located at the hub of the aerofoil of straight blade with a certain mass of the blade. In order to reduce the peak stress and average stress in the aerofoil at the tip, the taper is introduced with knowledge base engineering sensitivity study was performed with respect to the taper in the blade and it was observed that the study was successful in achieving 0(zero) stress at the tip and 17% drop in the stress values with respect to the base line model. The mass of the blade also got reduced. The third parameter considered is the twist in the blade. The peak stresses in the blade along with the taper and twist of 5$^0$ increases the maximum stress by 2%(52.642N/mm$^2$).Similarly for 10$^0$ and 15$^0$ twist the percentage increase in the stress is moved upto 3%. As the twist increases the stress is also increased. Taking the overall picture with respect to the base line model in the 1$^{st}$ case with the introduction of taper by 17% reduction of stress was achieved whereas with the introduction of twist of 0$^0$ - 15$^0$, the margin comes down by 3%. So with the effect of Taper and Twist combined it is possible to achieve around 14% (17%-3%) gain in structural integrity with decrease in mass of the blade. The results and the plot are as shown in Fig 2-3 and Table 1-2.

![Fig 1. Meshed model and Vonmises stress plot of Straight, Tapered and Taper & Twisted](image)

**Table 1. Results of Von Mises Stress**

<table>
<thead>
<tr>
<th>Blade Span Length</th>
<th>Straight Blade</th>
<th>Taper Blade</th>
<th>Taper +5deg Twist</th>
<th>Taper +10deg Twist</th>
<th>Taper +15deg Twist</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>62.6</td>
<td>52.1</td>
<td>52.6</td>
<td>53</td>
<td>53.1</td>
</tr>
<tr>
<td>10</td>
<td>59.9</td>
<td>47.7</td>
<td>47.7</td>
<td>47.7</td>
<td>47.5</td>
</tr>
<tr>
<td>20</td>
<td>53.4</td>
<td>43.8</td>
<td>39.3</td>
<td>39.2</td>
<td>39.1</td>
</tr>
<tr>
<td>30</td>
<td>46.7</td>
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<td>39.3</td>
<td>39.2</td>
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<tr>
<td>70</td>
<td>19.9</td>
<td>18.3</td>
<td>18.3</td>
<td>18.4</td>
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</tr>
<tr>
<td>80</td>
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<td>12.5</td>
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<td>12.6</td>
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<td>90</td>
<td>6.7</td>
<td>6.4</td>
<td>6.5</td>
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</tr>
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<td>100</td>
<td>0.75</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
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</tr>
</tbody>
</table>

![Fig 2. Average Von Mises Stress v/s % Blade Length Span](image)
From structural point of view, the natural frequencies of blade are equally important as that of the stress. The modal analysis is performed to evaluate the modal frequency and the blade dynamics. The aerofoil blade during centrifugal spin untwists itself due to centrifugal action and the increase in stiffness due to higher frequency is compared with straight blade frequency. From mass perspective the mass of the tapered blade is less than the straight blade due to twist resulting in higher frequency than the straight blade. This is very clearly evident as shown in the Table for straight, taper, taper and twist blades. The effect of stiffening is captured through prestress modal analysis and the results are tabulated in the tabular column 3-7. It is evident from the given blade length with and without prestress, the variation in the natural frequencies. With geometric softening the drop in the frequency is also indicated in Fig 4-8. The stress stiffening and spin softening effect is clearly captured for straight blade, taper blade and taper & twist blade. The twist option gives us a platform in tuning the blade by increasing or decreasing the twist. Hence the study is helpful in coming to conclusion to evaluate the sufficient separate margin required for structural integrity.

5.1. For Straight Blade
5.2. For Tapered Blade

![Frequency vs Speed Plot for Tapered Blade](image)

**Table 4. Frequency results for Tapered Blade**

<table>
<thead>
<tr>
<th>Angular speed 'rad/sec'</th>
<th>0</th>
<th>181.2</th>
<th>362.4</th>
<th>543.6</th>
<th>724.8</th>
<th>906</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Pre stress</td>
<td>191.69</td>
<td>191.69</td>
<td>191.69</td>
<td>191.69</td>
<td>191.69</td>
<td>191.69</td>
</tr>
<tr>
<td>With Pre stress</td>
<td>191.69</td>
<td>191.69</td>
<td>201.93</td>
<td>214.61</td>
<td>229.81</td>
<td>248.56</td>
</tr>
<tr>
<td>Spin Softening</td>
<td>191.69</td>
<td>191.69</td>
<td>182.82</td>
<td>171.05</td>
<td>153.69</td>
<td>126.29</td>
</tr>
<tr>
<td>Stress Stiffening</td>
<td>191.69</td>
<td>191.69</td>
<td>194.22</td>
<td>193.43</td>
<td>195.66</td>
<td>198.67</td>
</tr>
<tr>
<td>Spin Softening and Stress Stiffening</td>
<td>191.69</td>
<td>192.07</td>
<td>193.43</td>
<td>195.66</td>
<td>198.67</td>
<td>202.37</td>
</tr>
</tbody>
</table>

5.3. For Taper and 5° Twist Blades

![Frequency vs Speed Plot for Taper and 5° Twist Blades](image)

**Table 5. Frequency results for Taper and 5° Twist Blade**

<table>
<thead>
<tr>
<th>Angular speed 'rad/sec'</th>
<th>0</th>
<th>181.1</th>
<th>362.4</th>
<th>543.6</th>
<th>724.8</th>
<th>906</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Pre stress</td>
<td>191.71</td>
<td>191.71</td>
<td>191.71</td>
<td>191.71</td>
<td>191.71</td>
<td>191.71</td>
</tr>
<tr>
<td>With Pre stress</td>
<td>191.71</td>
<td>194.3</td>
<td>201.95</td>
<td>214.03</td>
<td>229.82</td>
<td>248.56</td>
</tr>
<tr>
<td>Spin Softening</td>
<td>191.71</td>
<td>193.52</td>
<td>182.81</td>
<td>171.07</td>
<td>153.69</td>
<td>126.31</td>
</tr>
<tr>
<td>Stress Stiffening</td>
<td>191.71</td>
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<td>248.51</td>
</tr>
<tr>
<td>Spin Softening and Stress Stiffening</td>
<td>191.71</td>
<td>192.08</td>
<td>193.43</td>
<td>195.66</td>
<td>198.67</td>
<td>202.39</td>
</tr>
</tbody>
</table>

5.4 For Taper and 10° Twist Blades

![Frequency vs Speed Plot for Taper and 10° Twist Blades](image)

**Table 6. Frequency results for Taper and 10° Twist Blade**

<table>
<thead>
<tr>
<th>Angular speed 'rad/sec'</th>
<th>0</th>
<th>181.2</th>
<th>362.4</th>
<th>543.6</th>
<th>724.8</th>
<th>906</th>
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<td>191.76</td>
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<tr>
<td>With Pre stress</td>
<td>191.76</td>
<td>194.08</td>
<td>202</td>
<td>214.04</td>
<td>229.87</td>
<td>248.56</td>
</tr>
<tr>
<td>Spin Softening</td>
<td>191.76</td>
<td>189.58</td>
<td>182.88</td>
<td>171.13</td>
<td>153.18</td>
<td>126.41</td>
</tr>
<tr>
<td>Stress Stiffening</td>
<td>191.76</td>
<td>194.29</td>
<td>201.92</td>
<td>214.01</td>
<td>229.8</td>
<td>248.55</td>
</tr>
<tr>
<td>Spin Softening and Stress Stiffening</td>
<td>191.76</td>
<td>192.14</td>
<td>193.51</td>
<td>195.74</td>
<td>198.75</td>
<td>202.46</td>
</tr>
</tbody>
</table>
5.5 For Taper and 15° Twist Blades

![Frequency vs Speed Plot](image)

Table 7. Frequency results for Taper and 15° Twist Blade

<table>
<thead>
<tr>
<th>Angular Speed rad/sec</th>
<th>0</th>
<th>181.2</th>
<th>362.4</th>
<th>543.6</th>
<th>724.8</th>
<th>906</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Pre stress</td>
<td>191.86</td>
<td>191.86</td>
<td>191.86</td>
<td>191.86</td>
<td>191.86</td>
<td>191.86</td>
</tr>
<tr>
<td>With Pre stress</td>
<td>191.86</td>
<td>194.47</td>
<td>202.1</td>
<td>214.17</td>
<td>229.95</td>
<td>248.72</td>
</tr>
<tr>
<td>Spine Softening</td>
<td>191.86</td>
<td>189.68</td>
<td>182.98</td>
<td>171.24</td>
<td>153.31</td>
<td>126.58</td>
</tr>
<tr>
<td>Stress Stiffening</td>
<td>191.86</td>
<td>194.39</td>
<td>202.02</td>
<td>214.1</td>
<td>229.89</td>
<td>248.65</td>
</tr>
<tr>
<td>Spine Softening and</td>
<td>191.86</td>
<td>192.24</td>
<td>193.61</td>
<td>195.64</td>
<td>198.86</td>
<td>202.57</td>
</tr>
</tbody>
</table>

VI CONCLUSIONS

The following are the conclusions made from the present work:

- In design of rotor blades, the centrifugal stress must be calculated because it is considered as the main source of stresses applied to the turbine rotor blade. The maximum stress is at the blade root.
- This paper reveals that the value of centrifugal stress can be controlled by just simply tapering the blades and the twist in the blade can incorporate the moments which are developed in the blade.
- Design of a constant stress blade gives a blade with less stress at the lower half and a similar stress at the upper half.
- The effect of taper and twist on the modal characteristics of cantilever beam are investigated.
  Variations of the two parameters affect the natural frequency of the blade which helps in blade tuning during design stage to avoid resonance at operating speed.

REFERENCES

ANALYSIS OF “DPHCF-RTT” PACKET FILTERING TECHNIQUE AGAINST DPHCF and DCHCF TECHNIQUES

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ABSTRACT

IP spoofing based DDoS attack is a DoS attack that relies on multiple compromised hosts in the network to attack the victim. IP spoofing makes the task of filtering illegitimate packets from the legitimate traffic of packets very difficult as IP addresses can be forged very easily. A number of mitigation techniques have been proposed related to higher computational time and low detection rate of illegitimate packets. In this paper, DPHCF-RTT has been analysed against other existing Probabilistic and Conventional Hop Count Filtering techniques. Goal is to improve the limitations of Conventional HCF or Probabilistic HCF techniques by maximizing the detection rate of illegitimate packets and reducing the computation time through DPHCF-RTT. It is based on distributed probabilistic HCF using RTT. It has been used in an intermediate system. Round Trip Time (RTT) provides valuable information that would help improve the efficiency of probabilistic DHCF technique which solely relies on Hop Count. DPHCF-RTT has shown a maximum detection rate up to 99% of malicious packets.

Keywords: DDoS, Distributed Conventional Hop Count Filtering (DCHCF), Hop Count Filtering (HCF), Distributed Probabilistic HCF (DPHCF), Intermediate System, Packet Filtering, Round Trip Time (RTT), TTL

1 INTRODUCTION

A Denial of Service (DoS) is an attack with the purpose of preventing legitimate users from using a victim server or network resources. Attacker fills the networks bandwidth with large amount of request packets that consumes the bandwidth and makes it difficult for the legitimate user to access the service in this attack. DDoS attack is a big threat to availability of services on the Internet. The attackers are not going to thieve, modify or remove the information exchanged on networks, but they attempt to impair a network service.
Without being authenticated on the Internet, any packet can be sent to anyone. It can be performed at network level, operating system level, and application level. Even the most popular websites like Twitter, Facebook, Google etc couldn’t escape from being hit by it, which caused millions of their users affected [9].

In this paper, section II presents Packet Filtering Techniques, section III presents DPHCF-RTT technique, section IV presents Results and Discussion, and lastly, section V presents Conclusions.

II PACKET FILTERING

Packet filtering is a process of controlling access to a network by analyzing the incoming and outgoing packets and letting them pass or halting them based on the IP address of the source and destination. Packet filtering is both a tool and a technique that is basic building block of network security [10].

In Hop Count Filtering, hop count is the number of hops a packet traverses when it moves from the sender to the receiver destination that can be used to check the authenticity of packet [3]. IP TTL field helps preventing packets from looping forever. TTL is introduced to specify the maximum lifetime of each packet in the Internet which is an 8-bit field in the IP header. Each intermediate router decreases the TTL value of IP packet by one before sending it to the next-hop. When a packet reaches its destination, the final TTL value is the initial TTL decreased by the number of intermediate hop counts.

When the TTL reaches zero or when the major difference occurs in the number of hops in the table in case of attack, the packet is discarded. No. of Hops cannot be falsified, although any field in the IP header can be forged by an attacker. An attacker cannot randomly spoof IP addresses while maintaining consistent hop-counts as the hop-count values are diverse [4]. The server can distinguish spoofed IP packets from legitimate ones using a mapping between IP address and hop counts. Source IP address spoofing means lying about the return address of a packet. Attackers can easily gain unauthorized access to a computer or a network by spoofing the IP address of that machine. It is important to examine hop-count distributions at various locations in the Internet as HCF cannot recognize forged packets whose source IP addresses have the same hop-count value as that of an attacker [5].

Ayman Mukaddam et al. [6] has proposed for victim side and conventional method of HCF has been used which is time consuming and not effective. Xia Wang et al. [7] are not trying to improve the packet filtering technique which is needed for elimination of random IP spoofing. The algorithm of Krishna Kumar et al. [1] requires a shared key between every pair of adjacent routers which requires lot of computational time and more than usual memory space. The probability based hop count filtering (PHCF) technique of B.R. Swain et al. [2] does not guarantee that the remaining unchecked packets will be legitimate only. Hence, this technique lacks in maximizing up to 100% detection of illegitimate packets from total packets. In the technique of Haining Wang et al. [5] attacker may also find the effective way by creating an effective IP2HC table to overcome HCF. Hence, this is also ineffective as legitimacy of packets is not sure [8].

Hence, after reviewing the literature, it is found that CHCF and PHCF techniques at distributed nodes, which are used to filter the malicious packets from the total packets, possess some limitations related to computational time, detection rate of illegitimate packets. Hence, there exists lot of scope to maximize the detection rate of illegitimate packets and reducing the computational time.
III DPHCF-RTT

DPHCF-RTT drops almost 100% of malicious packets which is not in conventional HCF where 90% of malicious packets are dropped and in probabilistic HCF where 80% to 85% of packets will be dropped. In DPHCF-RTT, Probability based distributed HCF along with RTT, every packet has been checked once for its legitimacy at the routers and then packet are transferred to the victim side [10]. At intermediate routers, malicious packets have been efficiently detected through DPHCF-RTT. The malicious packets, so discarded, do not contain any legitimate packets. The number of packets, definitely, remains unchecked considering some threshold value of packets to be malicious in total number of packets. The checked packets are passed to the victim server and the unchecked packets are passed on to the next router for further application of DPHCF-RTT technique on them. This process is carried out till no unchecked packet remains.

The effectiveness of DPHCF-RTT has been examined over PHCF and CHCF technique in respect of detection rate of malicious or illegitimate packets and computation time for filtering malicious packets [9]. In this paper, DPHCF-RTT technique has been analysed against DPHCF and DCHCF i.e. Distributed Conventional Hop Count Filtering to observe the effectiveness and efficiency of DPHCF-RTT over these two existing techniques.

IV RESULTS AND DISCUSSION

4.1 Detection Rate

DPHCF-RTT technique has been examined on different hops from 1 to 4 and for 30. It is found more efficient when larger numbers of intermediate nodes are considered. It gives high detection rate of malicious packets when compared with lesser number of hops below 4. Efficient results have been shown in getting detection rate of malicious packets up to 99.33%. Its detection rate consistently swings around the optimum value of 99% which is a good indication of packet filtering.

The comparison of effectiveness and efficiency of DPHCF-RTT technique has been shown in Fig. 1 in between DPHCF and DCHCF techniques. If maximum number of hops will be considered, it will definitely increase the detection rate of malicious packets up to approximately 100%.

<table>
<thead>
<tr>
<th>40000 pkts / sec on no. of Hops</th>
<th>Detection Rate Percent of DPHCF-RTT vs DPHCF and DCHCF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RTT+DPHCF</td>
</tr>
<tr>
<td>Hop nos. = 1</td>
<td>84.6643</td>
</tr>
<tr>
<td>Hop nos. = 2</td>
<td>93.7286</td>
</tr>
<tr>
<td>Hop nos. = 3</td>
<td>97.5786</td>
</tr>
<tr>
<td>Hop nos. = 4</td>
<td>98.1929</td>
</tr>
<tr>
<td>Hop nos. =30</td>
<td>99.5321</td>
</tr>
</tbody>
</table>
4.2 Computation Time

DPHCF-RTT filters malicious packets with minimum computation time as compared to DPHCF and DCHCF techniques as well as PHCF and CHCF techniques at the victim server for different number of hops at different arrival rate of packets. Hops = 1 in DPHCF-RTT takes very less computation time in contrast to more number of hops. This is due to high packet flooding and faster detection rate for a single hop. But, the accuracy of detection is not sure in contrast to more number of hops. In Fig. 2 comparison has been done between the DPHCF-RTT and DPHCF and DCHCF for 30 no. of hops. In Fig. 3, comparison has been done between DPHCF-RTT for number of hops = 4 with PHCF and CHCF techniques at victim server.

<table>
<thead>
<tr>
<th>Computation Time of DPHCF-RTT against DPHCF &amp; DCHCF Technique (in milliseconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPHCF-RTT(Hop =30)</td>
</tr>
<tr>
<td>DPHCF (Hop = 30)</td>
</tr>
<tr>
<td>DCHCF (victim Server)</td>
</tr>
</tbody>
</table>

Fig. 2 DPHCF-RTT vs. PHCF and CHCF (Hops = 30)
Fig. 3 DPHCF-RTT vs. PHCF and CHCF for maximum Packets Arrival Rate = 400000

V CONCLUSION

Performance of DPHCF-RTT has been analysed and compared with PHCF and CHCF techniques at intermediate nodes as well as at the victim server. Basis of comparison are Detection rate of malicious packets and the computation time Detection rate of malicious packets of DPHCF-RTT have been found up to 99% as compared to PHCF and CHCF techniques. Also, the computation time for filtering illegitimate packets has been found to be reduced for DPHCF-RTT drastically and found effective as compared to PHCF CHCF techniques at intermediate nodes as well as at the victim server. DPHCF-RTT can be implemented on real-time environment or on the cloud platform for maximum number of intermediate nodes up to 30 in the future.

REFERENCES


