SANKALAN:-

The Journal of Science, Technology & Humanities

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MESSAGE AND NOTE THROUGH DESK

[A]. Patron - in - Chief: – Prof. S.K. Singh

He is the Chairman of Vidyadaan Institute of Technology & Management, Ariaon, Dumraon, District: Buxar, (Bihar), 802119. He has completed his graduation degree in Engineering in Electronics & Communication Engineering, from B.I.T. Sindri, in 1986 and postgraduate in Business Management from X.L.R.I. Jamshedpur, in 2004.

He has 30 years of wide experience in applied Research, Product Development and Program Management besides developing algorithms and their implementation for real-time embedded applications for signal processing in technologies like Software Defined Radio, Digital Subscriber Line, Cable Modem, Meteor Burst Communications and Satellite communications.

Background Highlights:-

- 1986 - 1997, Defence Research & Development Organization (D.R.D.O.) as Scientist
- 1997 - 2006, As Engineering Manager / Program Manager in Multinationals like, Freescale Semiconductor, Ishoni Networks, General Electric Plessey etc.
- 2006 - 2008: Cofounded a Telecom Company Hertz Tele Networks Pvt. Ltd
- 2008 - 2010: Director: Genesis Futuristic Technology Ltd, Noida
- 2010 till date: Founded Vidyadaan Institute of Technology and Management (V.I.T.M.), Buxar
- He had Co-authored a paper on the issue of inter modulation products for D.S.P. based Modulators in 2nd International Symposium on "D.S.P. for Communication Systems" held at Adelaide in 2004. D.S.P. based Modulators: Problems and Solutions.

Message from the Patron - in - Chief's Desk:-

"SANKALAN:- The Journal of Science, Technology & Humanities" (I.S.S.N. Online:- 2455 - 3557) is a Journal started with a goal to publish innovative ideas which proposes value in creating technologies for tomorrow and solving problems of today right from concept to implementation.

This Journal will try to set an example for extending opportunities to scholars of different field to publish their papers with ethics and honesty. I wish a grand success to all the stakeholders of the Journal.

[B]. Director – V.I.T.M., Buxar – Prof. (Dr.) A.K. Verma

He is the Director of V.I.T.M., Buxar, Bihar. He had earned M.Sc. in Radio Physics and Electronics in 1982 from B.R.A. Bihar University, Muzaffarpur, Bihar. Also, he earned Ph.D**.** in Communication Engineering in 1993 from B.R.A. Bihar University, Muzaffarpur, Bihar. He has 31 years of vast experience in the fields of academics & research.

Background Highlights:-

- Defence Research & Development Organization (D.R.D.O.) as Senior Scientist from 1985 - 1997 and 2003 - 2007

- Department for Development of North Eastern Region (DoNER), Govt. of India, (North Eastern Council, Shillong on Deputation from D.R.D.O.), August 97 - July 2003

- Director, "Genesis Futuristic Technologies Pvt. Ltd" - 2007 – 2010

- Vidyadaan Institute of Technology and Management (V.I.T.M., Buxar) – Director: 2010 till date

- Worked on Microwave and m.m. wave system, V.H.F. / U.H.F. System, H.F. and N.V.I.S. H.F. System (Moving Platform), Buried H.F. Communication System: Link Design, System Integration and Communication Planning and measurement

- Worked on Synthetic Aperture Radar (S.A.R.) Image Processing; Digital Image Processing (Visible and I.R.); Registration; Target Classification; Target Identification; A.I., K.B. & Fuzzy System, Neural Network; S.A.R. Interferometry for D.E.M. Generation; S.A.R. Interferometry: Phase Unwrapping Techniques; Moving Target Identification; Disaster Assessment; Differential S.A.R. Interferometry; Real Time Image Processing Techniques; Remote Sensing Applications for development of various thematic maps and disaster management system.

- Worked on Techno-socio-economic analysis; Modelling the impact of technology for quality of life; Space Technology based Disaster Management System; Information Technology Program implementation, Management of the functioning of Technical / Medical Educational Institutes of North Eastern States; Science and Technology and Earthquake related research program

Message from the Director's Desk:-

We have started an International Journal – SANKALAN: - The Journal of Science, Technology & Humanities, (I.S.S.N. Online: - 2455 - 3557) this year. I think, this work will enhance the research and academic oriented responsibilities in several disciplines in todays and future era. I also, invite the professionals, research scholars, academicians and the concerned people from various domains to participate by their work and serve the nation and world in the emerging & innovative domains. Lastly, I want to thank the whole team of SANKALAN by whom we have done this unique task. Thank you all.

[C]. Executive Editor / Publisher: - Rahul Rai

He is working as Assistant Registrar at B.I.T. Mesra, Ranchi, Jharkhand. His areas of interest are Analytics, Marketing & Entrepreneurship. He is M.B.A with Distinction Marks from B.I.T.S., Pilani, Rajasthan and B.Tech with Distinction in IT and Management. He has 06 years of industrial experience in Analytics and Research industry.

Background Highlights:-

- Worked as Academic Associate in Department of Management, B.I.T.S., Pilani, Rajasthan
- Qualified All India Level :- U.G.C. National Eligibility Test – Junior Research Fellowship (U.G.C. – N.E.T – J.R.F.) in Management in the year 2013
- Diverse Experience in various domain like Banking, Retail, Media & Marketing
- Awarded Many Prizes and appreciations in the career in several fields till date
- Organized & Participated in several seminars and events till date

Note from the Publisher / Executive Editor's Desk:-

Wishing you all a great year ahead!!!

Firstly, I will pay my gratitude to Almighty, my parents and all well-wishers with whose blessings and support we are able to start this journal "**SANKALAN:-The Journal of Science, Technology and Humanities",** (I.S.S.N. Online: - 2455 - 3557) We have started this journal publication under flagship of Vidyadaan Institute of Technology and Management to provide a forum for publishing new findings on Science, Technology and Humanities.

I hope this initiative will bring great value for academicians, researchers, students and all those who are involved in Research & Development work. We do have a highly reputed pool of advisory board members from well renowned universities, who help us in keeping high benchmark for quality and originality of our publications. Hence, I am confident that our mission to be the leading Research Journal in field of science, technology and humanities will very soon become true.

I also feel great about the fact that Vidyadaan Institute for Technology and Management is doing a great job both in field of imparting technical education and providing great placement opportunities for students coming from different parts of nation. I hope very soon Buxar-Land of Rishi Vishwamitra; will soon become educational hub of Bihar.

[D]. Editor - in - Chief: - Rishabh Rai

He is the Editor in Chief of this Journal. His areas of interest are Digital System Design, Communication Systems, Nanotechnology, Embedded System Design, Wireless & Mobile Communications & Low Power V.L.S.I. Design. He is M.Tech in V.L.S.I. Design specialization with Distinction Marks & B.Tech in Electronics & Telecommunication Engineering with Honours.

Background Highlights:-

- Appreciated by the Government of India for the quality publication of the Journal – Sankalan :- The Journal of Science, Technology & Humanities (E-ISSN - 2455-3557)
- Earned the respective academic degrees in the career till date i.e. (Class Xth to M.Tech.) with Distinction / Honours in aggregate
- Published 20 Technical / Research / Review / Study Papers in several National / International Conferences and Journals till date
- Awarded Honorarium & Appreciated for the Paper Publication by A.K.G.E.C. International Journal of Technology in 2016
- Appreciation for the Academic Performance in M.Tech. – (2013 – 2015)
- Academic Excellence Award , for the aggregate performance in B.Tech (2009 - 2013)
- I.E.E.E. National Merit Award – 2013, for the best Paper Presentation in National Conference - E.T.E.A.T – 2013
- Project Selection in the Sixth Science Conclave – 2013, at I.I.I.T Allahabad
- Amul Vidya Bhushan Award – 2009, for the academic excellence & performance in A.I.S.S.C.E. – 2009

Note from the Editor - in - Chief's Desk:-

Firstly, I am thankful to god and grateful to my venerated parents, and all those whose blessings and constant encouragement have helped me to complete this work, i.e. compilation and finalizing of the current issue of the Journal, "**SANKALAN:-The Journal of Science, Technology and Humanities", (I.S.S.N. Online: - 2455 - 3557)**. Authors are requested to emphasize on novel theoretical standard and downtrodden concerns of the mentioned areas against the backdrop of proper objectification of suitable primary materials and documents. The papers must not be published, copied in parts or whole or accepted for publication anywhere else. For more information and ideas, one must visit the **"Quality & Plagiarism Check"** for such issues, as given in the website www.sankalan.org .

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OBJECTIVES:

- ❖ To develop and promote academic research activities on various contemporary techno-engineering issues and trends in management and humanities.
- ❖ To provide a platform to discuss the problems related to the technical as well as the managerial and research issues.

The most valuable and suggestive comments of all the readers are always awaited and welcomed in order to achieve the ultimate goal. We are looking forward for your contributions. All communications must be made only in electronic form e-mailed to:

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Review on Vibrations of Electric Motors

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***Abstract*—Vibration problems in electric motors are annoying and significantly reduce its efficiency. To enhance its performance, these vibration problems are necessary to be controlled. Many researches are focused on finding the causes of vibration in the electric motor and attempts were made to lessen them. By utilizing the proper data collection and analysis techniques, the actual source of vibration can be found. Basic sources of vibration include electromagnetic factors, electrical imbalance, mechanical imbalance, stiffness of base, resonance, etc. In this work an attempt is made to represent the findings of the causes of vibration in electric motor and the methods developed to reduce it. The review is structured as major sources of vibration, experimental modal testing methods, and effect of changes in the structural stiffness on the natural frequency of the structure.**

Keywords—Electric motor; vibration; resonance; mode frequency; mode shape

IV. INTRODUCTION

All machines have natural frequencies that are defined by the complex relationship of masses, stiffness, and dampers within a structure. These natural frequencies may be localized to a small area of a machine, e.g., an overhanging terminal box, or may be more structural in nature, applying to the entire machine and foundation. Regardless of the scope, however, the existing natural frequencies within a machine may adversely affect its overall vibration performance. The correlation between a machine's vibration and its natural frequencies depends upon the magnitude and direction of the forcing functions. Scott Kreitzer [2] identified common mode shapes, namely, end to end rocking and side-to-side rocking.

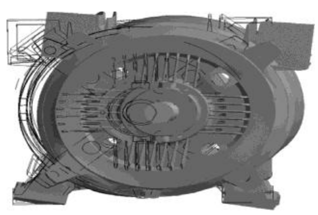

Fig. 1. Side-to-sideocking mode.

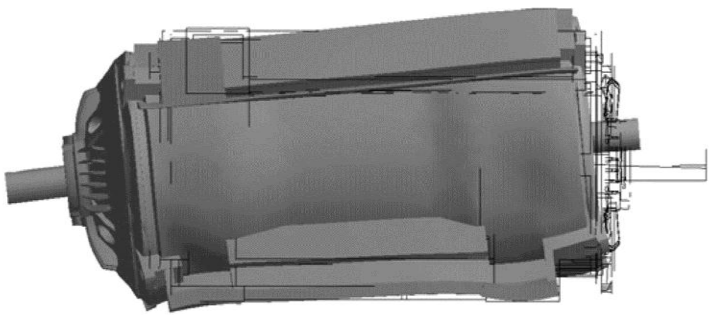

Fig. 2. End-to-end rocking mode.

When a natural frequency is excited by a forcing function of the same frequency and direction, a resonance occurs, often leading to appreciable vibration levels within the machine which are known to wasting energy and creating unwanted sound. Therefore, many researches have focused on the sources of vibrations, its effects and figuring out ways to diminish them.

V. SOURCE OF VIBRATION

There are many electrical and mechanical forces present in induction motors that can cause vibrations. Additionally, interaction of these various forces makes identification of the root cause elusive. Costello [8], Timar et al. [5], Ozturk et al. [6], Eis [7], Finley [9] [4] handled noise and vibrations in electrical machines with causes, results and diagnosis. Electric sources of vibration include magnetic flux and twice line frequency vibration. Electrical machines exhibit mechanical vibrations at two times line frequency. This phenomenon is caused by the magnetic field expanding and collapsing in the iron core [2].

Since electric motor is a mechanical device, mechanical forces also play a major role in causing vibrations. Unbalancing is found to be a major cause of vibrations which can be classified as mechanical, thermal, coupling unbalance, driven-machine unbalance and motor unbalance[4]. Mechanical unbalance can be caused by an eccentric rotor, eccentric bearing journals, or a bent shaft whereas thermal unbalance is caused by shorted rotor laminations, unequal rotor core stacking pressures, a tight rotor-to-shaft fit, or residual core stresses. On the other hand coupling unbalance is caused by coupling misalignment and/or unbalance. Other causes include faults such as misalignment, looseness, rubbing, bearing faults including eccentricity, cavitation, oil whirl, and oil whip and misalignment at the coupling or uneven torque produced by the driven equipment.

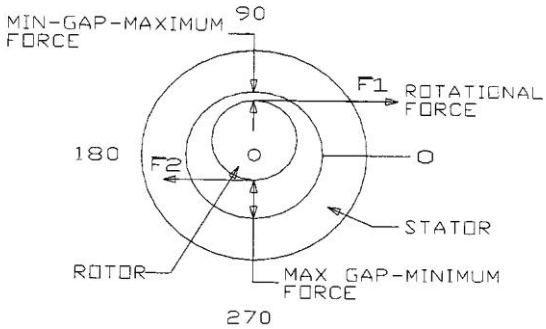

Fig. 3. Exaggerated view of eccentric rotor [4].

Scott Kreitzer, Jason Obermeyer and Rajendra Mistry discussed the foot sensitivity and motor base [2]. The magnitude of vibration due to a structural resonance can be strongly affected by the contact between the foundation and the motor feet. The perfect case for a good design would be a totally bonded contact between the foot and the foundation. However, in reality, this condition does not exist. All motor feet have some degree of irregularity and imperfect flatness. API 541 4th Edition requires that all four motor feet lie within 0.005 in of a common parallel plane [10]. The foot flatness of motors with weak frames may also change once the stator core is inserted into the frame.

Additionally, the method of attaching the feet to the foundation affects the vibration of a motor. The effect of partial foot contact and full contact was seen experimentally and through finite element study. The model with the partial foot contact yielded frequencies that were significantly lower than the model with full contact.

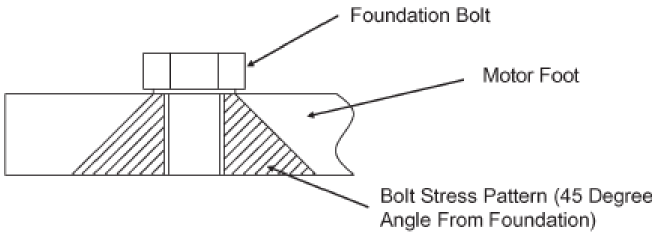

Fig. 4. Cross section of motor foot, partial-foot contact model [2].

TABLE I. STRUCTURAL NATURAL FREQUENCIES OF VARIOUS FOOT MOUNTING CONFIGURATIONS—ANALYTICAL AND EXPERIMENTAL (IN HERTZ) [2]

	Full Foot Contact (Calculated)	Partial Foot Contact (Calculated)	Actual Test Data (Rap Test)
1st Mode	51	40	43
2nd Mode	130	104	112

Again, if the motor is mounted on a weak base, the impact of the base vibration is transmitted into the motor. API 541 has defined a "massive foundation" as one in which the vibration of the base at the motor foot is to be less than 30% of the vibration at the motor bearing housing [10]. A weak base may be detected by measuring the horizontal vibration at the ground level, at the bottom, middle, and top of the base, and at the top of the motor frame. When the base stiffness is very low, the motor's operating speed may correspond with the natural frequency of the base which leads to resonance. Various sources of vibration are tabulated in Table 2 [4].

TABLE II. SOURCES OF VIBRATION IN ELECTRIC MOTORS [4]

CAUSE	FREQUENCY OF VIBRATION	PHASE ANGLE	AMPLITUDE RESPONSE	POWER CUT	COMMENTS
Misalignment: ① Bearing	Primarily 2 x Some 1 x Radial High at DE and Axial	Phase angle can be erratic.	Steady.	Drops slowly with speed.	① 2 x can dominate during coast-down. ② 2 x is more prevalent with higher misalignment.
Misalignment: ② Coupling	Primarily 1 x Some 2 x Radial High at DE and Axial	Drive 180° out Phase with NDE.	Steady.	Level drops slowly with speed.	① Parallel causes radial forces and angular causes axial. ② Load dependent.
Rub - ① Seal/or bearing	1/4x, 1/3x, 1/2x or 10-20x can be seen Primarily 2 x Some 1 x. Radial.	Erratic.	Erratic depending upon severity.	Disappears suddenly at some lower speed.	① Full rubs tend to be 10 to 20x higher. ② Bearing misalignment can give rub symptoms.
② Rotor	1/4x, 1/3x, 1/2x, & 1x with slip freq. side bands. Radial.	Erratic.	High.		① Severe pounding.
Looseness: ① Bearing (non-rotating)	2 x 3 x may be seen Radial	Steady.	Fluctuates	Disappear at Some lower speed	① Bearing seat looseness. ② Looseness at bearing split.
② Rotor Core (rotating)	1-10x with 1, 2, & 3 predominant. Radial	① Can exist relative to type of looseness ② General core loose gives erratic symptom.	Erratic, high amplitude	① Drops with speed. ② Can disappear suddenly.	① End plates loose. ② Core ID loose.
③ Pedestals (non-rotating)	1-10x with 2 & 3 predominant Radial & Axial	Steady.	Fluctuates.	Disappears at some lower speed.	
④ External Fans	1 & 3 x Radial & Axial – OE (fan end)	N/A	Fluctuates.	① Drops with speed. ② Can disappear suddenly.	
Unbalance Rotor	1x rotor speed. Radial	① NDE & DE in phase. ② Couple gives out of phase condition	Steady.	Level drops slowly.	Rotor has unbalance - can be due to thermal problems.
Unbalance of External Fan	① 1X Radial high at NDE (fan end). ② 1X Axial with high at fan end.	① Couple DE 180° out of phase with EO.	Steady.	Level drops slowly.	
Coupling Unbalance	1 x Radial & higher on drive end		Steady	Level drops slowly	Unbalance due to coupling or key
Bent Shaft Extension	2 x Primarily 1 x may be seen Axial	EO 180° out of phase with DE.	Steady.	Level drops slowly.	DE runout should give higher 2x axial at that end. Normal runout on core - 1-2 mil.
Eccentric Air Gap	Strong 120 Hz Radial	N/A	Steady	Immediately drops	Difference between max. and min. air gap divided by ave. should be less than 10%.
Soft Foot Eccentric rotor.	1x Primarily Some 60 & 120 Hz Radial	Unsteady.	Modulates in amplitude with slip	Immediately drops	① Eccentricity limit 1-2 mil. ② Slip beat changes with speed/load.
Loose stator core.	120 Hz. Axial & radial	Frame & bearing brackets in phase at 120 Hz	Steady	Immediately drops	① Look for relative motion of core with respect to housing.
Rotor Bow (Thermal Bow)	1x Primary Some 120 Hz may be seen May have Modulators on 1X & 2X vib. - Radial	Unsteady	① Changes with temperature. ② Time or load related. ③ Varies at Freq. slip x poles	Some drop but high level would come down with speed.	① Heat related. ② Examine rotor stack for uneven stack tightness or looseness. ③ Shorted Rotor Iron ④ Check bar looseness.

CAUSE	FREQUENCY	PHASE ANGLE	AMPLITUDE OF VIBRATION	POWER CUT	COMMENTS
Broken rotor bars	1x and modulates at slip x # poles May have high stator slot frequencies On slower speed Motors	Dependent upon where broken bars are located.	STRONG BEAT POSSIBLE. - Varies @ Freq. Slip x poles - Amplitude increased with load	Immediately drops	① Sparking in the air gap may be seen. ② Long term variation in stator slot frequencies can be indicator of bar problems. ③ Broken bars cause holes in magnetic field. ④ Large current fluctuations. ⑤ Current analysis shows slip frequency side bands.
Loose bars.	① 1 x Possible balance effect with thermal sensitivity. Radial ② Stator slot freq. plus sidebands @ ±(# Poles*Slip)	1. 1 x vibration will be steady 2. Stator slot freq. will modulate causing a fluctuation in phase angle on overall vibration	Steady	① Stator slot freq. will immediately disappear. ② Imbalance effect can suddenly disappear at some lower speed.	Excessive looseness can cause balance problems in high speed motors.
Interphase fault	60 & 120 Hz Radial	N/A	Steady and possible beat.	Immediately disappears.	
Ground fault	60 Hz & 120 Hz slot freq. - Radial	N/A	Steady and possible beat.	Immediately disappears.	
Unbalanced Line Voltages	120 Hz Radial	N/A	Steady 120 Hz & Possible beat.	Immediately disappears.	
Electrical Noise Vibration	(RPM x # of Rotor slots)/60 +/-120, 240, etc. - Radial	Due to modulation overall vibration will fluctuate	Steady	Immediately disappears	Increases with increasing load.
System Resonance	1 x RPM or other forcing frequency One plane – usually Horizontal	Varies with load and Speed	Varies	Disappears rapidly.	Foundation may need stiffening- may involve other factors
Strain	1 x RPM		Steady		Caused by casing or foundation distortion from attached structure (piping).
Poorly shaped Journal	2x Rotational Usual	Erratic	Steady	May disappear at lower speed	May act like a rub.
Oil Film Instability (Oil Whirl)	Approx. (.43-.48)*rotational	Unstable	Steady		
Anti-Friction Bearing Problems	Various Frequencies dependent on bearing design	Unstable	Steady		Four basic frequencies.
Resonant Parts	At forcing Frequency or Multiples	N/A	Steady♣	Drops rapidly	May be adjacent parts
Top Cover Fit	120 Hz. Radial	N/A	Steady.	Disappears immediately.	① Magnification of 120 Hz electrical. ② Top cover rests on basic core support.

VI. Experimental Modal Testing Methods

After all the common electrical and mechanical causes have been eliminated, resonance can be assigned as the cause of vibration further. To substantiate the problem of resonance, the natural frequency of the whole structure is to be known. Hence, it becomes necessary to find methods to determine natural frequency of the individual components. Scott Kreitzer [2] has mentioned certain methods to find natural frequency of the structure, namely Coast Down test, Variable Frequency test and Impact testing. The Coast Down test comprises of running the motor at a rated speed with no load and then cutting the power which allows the motor to coast to a stop. This test is easy to perform but with a major disadvantage that the type of resonance (rotor dynamic, structural and localized) and the mode shape of the resonance remain unknown, while the Variable Frequency Test, which involves running the motor under full or partial load at various frequencies, is difficult to perform and requires a lot of time for completion. One of the best methods to measure the resonant frequency of a structure is through an impact test, which is also known as rap test. Rap test involves the use of fast Fourier Transform (FFT) analyzers with connections to an accelerometer, placed in various positions, and a force input. It excites all the natural frequencies all together and provides understanding of the mode shapes of the structure. This test provides data in terms of vibration magnitude versus vibration frequency.

VII. Vibration Reduction

Many researchers have dealt with the problem of reducing vibrations and acoustic noise in electric motors and since then a series of developments have been made in this field. Initially, many papers were focused on computation of natural frequency of the motor and the stator [11]–[13]. After the introduction of new techniques like modal analysis and finite-element analysis (FEA), the natural frequency of the motor was analyzed in detail [14]. Further, J. L. Besnerais et al [15] and T. Ishikawaet al [16] found that even a 2D FEM model was enough to analyze acoustic noise and vibration through the study of approximate 2-D mechanical FEM model. Fuminori Ishibashi, Makoto Matsushita, Shinichi Noda, and Kenzo Tonoki [3] studied the mechanical natural frequencies from the yoke steel ring to the motor using seven models. This study was done experimentally, analytically, and by mechanical FEM step by step. Analysis of the natural frequency of each stage provided the origin of each natural frequency and made it possible to accurately determine the natural frequency by calculations. Numerical analysis of natural frequency was done with a general-purpose structural FEM program NASTRAN, and frame deformation was done with a FEM program ABAQUS. As the configuration of the ring became more complex, such as the core with windings and stator, the number of natural frequencies increases, and the natural frequencies decrease. Step analysis of the stator and motor provides the individual effects of adding components and an accurate simulation process.

TABLE III. Specification Of The Experimental Model [3]

Model	Specification
1	Steel ring (equivalent to yoke)
2	Steel ring with cuts
3	Steel ring with cuts and holes
4	Laminated stator core
5	Stator core with coil and without end winding
6	Stator core with coil and end winding
7	Motor

Measured Mechanical Frequency (In Hertz) [2]

Mode	Model 5	Model 6	Model 7	
			Measured	Calculated
2	1574	1382	1250	1245
2	1724	1461	1525	1562
2	—	1960	1850	1804
2	—	2076	2052	1984
3	4208	4010	4025	3973
3	4415	4230	4192	4241
4	7430	7172	4974	5080
4	7668	7380	5630	5597
0	9122	8903	—	—

Since there was no global engineering procedure that covered the majority of both design and analysis aspects and concepts, M. A. Nasser [1] proposed predictive engineering "design and analysis" process and applied it for the analysis of an electric motor at both component and full motor structure levels. The predictive engineering process steps were; defining the concept of design, modelling, simulation, analysis and a results review. Initially component re-modelling was done and further the model validation and design modification were attained. Since the interface between the bearing and rotor was considered as rigid coupling, the bearing did not damp any vibrations.

The octagonal shape of the stator improved the dynamic behavior by enhancing its natural frequency. Further, the addition of axial and radial ribs and annular plate on the housing considerably modified the mode shape and augmented its mode frequencies. In order to verify and validate the model, experimental modal analysis was done.

Scott Kreitzer [2] stated that the width and stiffness of the motor base may adversely affect the natural frequency of the whole motor and, ultimately, the overall vibration of the motor.

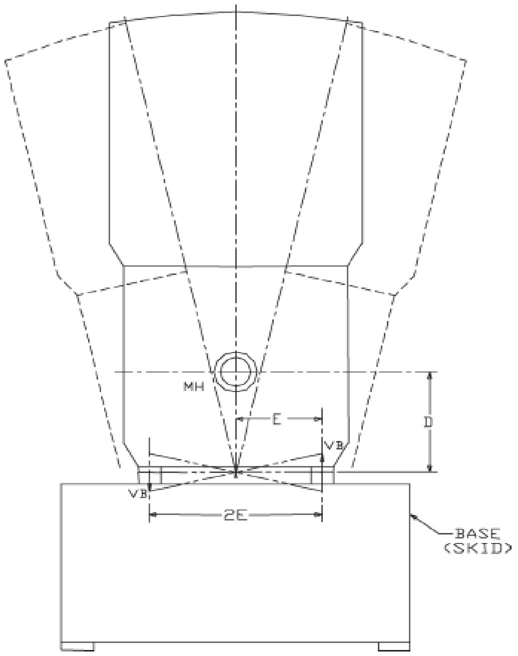

Fig. 5. Motor rocking due to weak base [2].

VIII. CONCLUSION

Based on the literatures from various research articles for the electric motor, the sources of vibration, its identification methods and procedures for its reduction, following observation was made:

- Most of the researchers have considered the effect of electromagnetic forces only.
- Many researches considered high axial stiffness and hence only 2D FEM analysis was done.
- Researches have generally focused on the modal analysis of individual components of the electric motor and the 3D analysis of the complete assembly has not been done so far.
- Meager researches have been done on the improvement of the motor casing for increasing natural frequency because of its geometrical complexity.
- Fewer researchers have considered the role of mounting in vibration dampening.

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FACE DETECTION USING MATLAB

(An Image Processing Based)

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ABSTRACT:- Face detection has been a fascinating problem for image processing researchers during the last decade because of many important applications such as video face recognition at airports and security check-points, digital image archiving, etc. In this paper, we attempt to detect faces in a digital image using various techniques such as skin color segmentation, morphological processing, template matching, Fisher linear discriminant (FLD), eigenface decomposition, and support vector machines (SVM). We determined that the more complex classifiers did not work as well as expected due to the lack of large databases for training. Reasonable results were obtained with color segmentation, template matching at multiple scales, and clustering of correlation peaks.

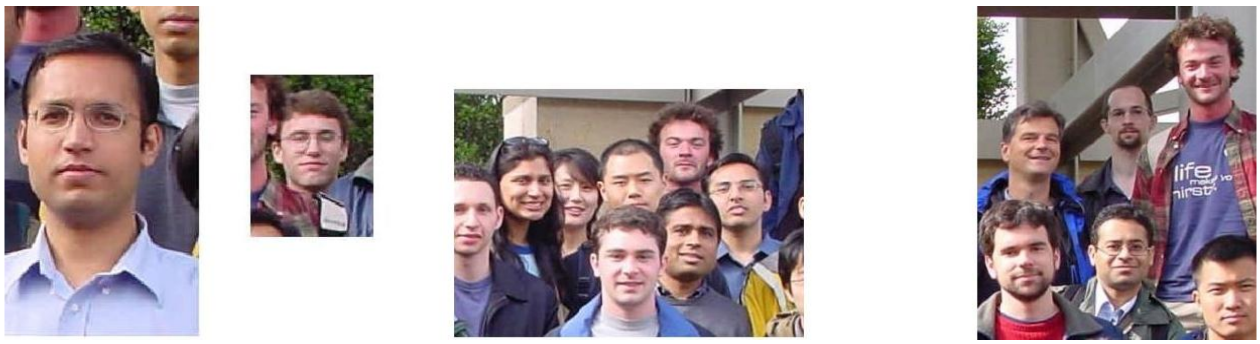
I. INTRODUCTION:-

Automatic face detection is a complex problem in image processing. Many methods exist to solve this problem such as template matching, Fisher Linear Discriminant, Neural Networks, SVM, and MRC. Success has been achieved with each method to varying degrees and complexities. The assignment given to us was to develop an algorithm capable of locating each face in a color image of the class. We were given seven training images along with the corresponding ground truth data to develop and train our algorithms on. The end result for our group was an algorithm capable of finding over 95% of the faces in all but one image in approximately 30 seconds. In addition, we are able to successfully locate one of the females in two test images.

The goal of this project is to detect and locate human faces in a color image. A set of seven training images were provided for this purpose. The objective was to design and implement a face detector in MATLAB that will detect human faces in an image similar to the training images has been studied extensively. A wide spectrum of techniques have been used including color analysis, template matching, neural networks, support vector machines (SVM), maximal rejection classification and model based detection. However, it is difficult to design algorithms that work for all illuminations, face colors, sizes and geometries, and image backgrounds. As a result, face detection remains as much an art as science.

Our method uses rejection based classification. The face detector consists of a set of weak classifiers that sequentially reject non-face regions. First, the non-skin color regions are rejected using color segmentation. A set of morphological operations are then applied to filter the clutter resulting from the previous step. The remaining connected regions are then classified based on their geometry and the number of holes. Finally, template matching is used to detect zero or more faces in each connected region. A block diagram of the detector is shown in Figure1

Figure.1. **Original face.**

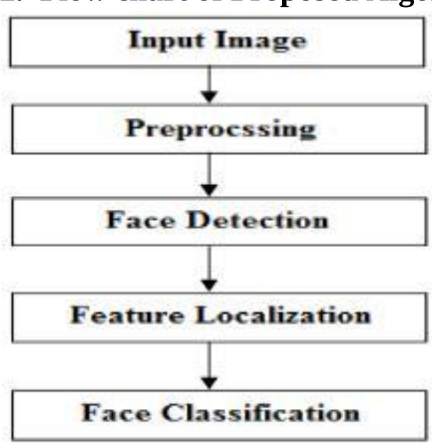


The final paper for this year consisted of the challenge of correctly locating the faces of the students in the class in several outdoor photographs, with extra credit being awarded for identifying females. The images were provided at quite high resolution and were taken with reasonably consistent lighting but the relative sizes of the faces varied with the degree of zoom of the camera. Most of the images further exhibited significant overlap of faces with little or no border between them.

II. PROPOSED ALGORITHM :-

The face detection in color images based on intensity function is specified as follows:

Figure.2. Flow chart of Proposed Algorithm



III. ALGORITHM FOLLOWED:-

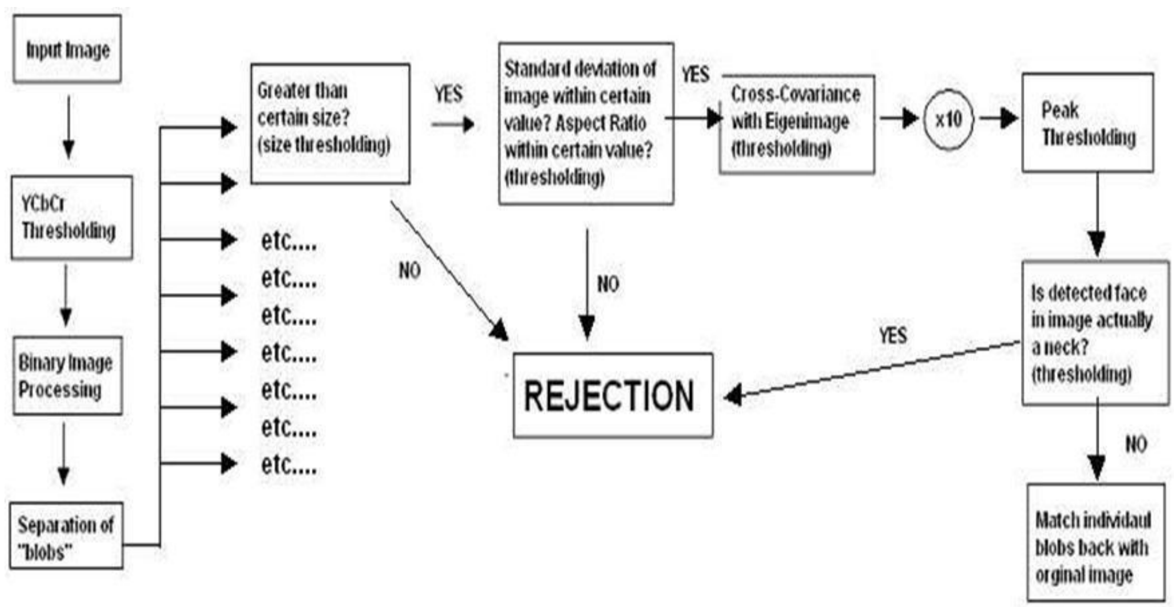


Figure.3. block diagram of algorithm

IV. FACE-DETECTION MECHANISM

The basic form of this algorithm follows a process that was very common among former students. The following two steps are performed: Using these techniques, the faces in the training images were recognized quite more general circumstances, for this approach

1 Skin Detection – Since the training set and the final image are all full color images, this is the separation of skin pixels from non-skin pixels can be accomplished quite effectively.

2 – Template Matching – By running only the skin pixels through a template matching algorithm, the faces can be separated from other visible skin such as arms or legs.

V. SKIN SEGMENTATION:-

The first step in the face detection algorithm is using skin segmentation to reject as much "non-the face" of the image as possible, since the main part of the images consists of non-skin color pixels. There are two ways of segmenting image based on skin color: converting the RGB picture to YCbCr space or to HSV space. A YCbCr space segments the image into a luminosity component and color components, whereas an HSV space divides the image into the three components of hue, saturation and color value.

The main advantage of converting the image to the YCbCr domain is that influence of luminosity can be removed during our image processing. In the RGB domain, each component of the picture (red, green and blue) has a different brightness. However, in the YCbCr domain all information about the brightness is given by the Y-component, since the Cb (blue) and Cr (red) components are independent from the luminosity. The following conversions are used to segment the RGB image into Y, Cb,Cr components

0.257 0.504 0.09 1
* R * G 8 * B6

0.14 0.43 1
8 * 0.29 9 *2
R 1* G B 8

indication on whether a pixel is part of the skin or not. This can clearly be seen in Figure (above) which are the Cb and Cr values of all the pixels that are part of the faces in the first fiveimage-differentiated using the "ground truth data" on the project website. There is a strong correlation between the Cb and Cr values of skin pixels, as shown in figure 2. Figure 3 shows the Cb and Cr components of the entire training image, to reveal the comparison between faces and nonfaces in the YCbCr space. From these figures, it is apparent that background and faces can be distinguished by applying maximum and minimum threshold values for both Cb and Cr components. Note, however, that even with proper thresholds, images containing other parts of the body, such as exposed arms, legs, and other skin, will be captured, and must be removed in image processing steps.

The resulting skin mask appears to contain only skin pixels, but it also appears to have some holes. To resolve this problem, some binary morphological processes were performed. The image was first dilated in order to try to connect the pixels in each individual face. A "filling" step was then performed to fill in any holes such as in the eyes and under the chin. Finally, the image was eroded to remove the extra pixels that were selected around the edges of the faces during the dilation step. Figure 5 below shows an example of the final step of this procedure.

Figure .5. Example of Result of Skin Detection Step

RESULT:-

The proposed model was implemented using 7 images. The performance of our proposed method is better than that of existing color image enhancement algorithms. Experiments show that the proposed algorithm for face detection has a very good performance in detecting low quality faces and faces affected by environmental lightning conditions. However, it is sensitive to pose rotated faces and faces corrupted by other objects.

The detection rates and false positive rates on test sets are listed in Table 1. Note that the false detection especially is very low, while the detection rate is acceptable. Examples from the face database are shown in Figures 5-8.The proposed model was implemented using five images.

Conclusions: As the initial step of the algorithm, color-space separation was by far the most effective means of eliminating non-face regions from consideration. For the subsequent face-segmentation step, we found that the very simple method of looking for face-like shapes within the skin-probability image to be effective and computationally efficient. We did not have much success with morphological processing nor detection based on actual face features such as they eyes and mouth. These more sophisticated approaches certainly have merit in a more general-purpose face detection program. However, with our very consistent and predictable set of training images, the simplest approach proves to be more than adequate, as is evidenced by the overall accuracy rating of 98%, and quick execution time of roughly one minute.

Figure 6. All faces have been detected.

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MOBILE SATELLITE SYSTEM SIGNAL RECEPTION: A REVIEW

A. Kumar

***Abstract*—Present paper carries out a review of different channel impairments that exist in Satellite signal propagation and techniques that could be used to compensate for the same. Mobile Satellite Systems (MSS) are used to provide reliable contiguous coverage by combining the Satellite and the terrestrial cellular networks to take their respective advantages. High frequency operation, channel impairments, existence of LoS component etc. must be properly accessed for radio channel modelling of the system. This paper discusses some of these signal degradation mechanisms prevailing in Satellite links. Finally, some reception improvement techniques in view of the MSS is presented.**

***Index Terms*—** *Mobile Satellite Systems; fading; MIMO; polarization; LNA.*

I. INTRODUCTION

Historically, Mobile Satellite Systems (MSSs) have been used in Marine and Military Communications for providing the seamless connectivity to mobile users in regions where no other means of network can be established. MSS have also been successfully utilized in disaster management situations when all other forms of communication systems fail to respond. Recently, Hybrid Mobile Satellite Systems (HMSS) [1] have been opted in several countries due to the possibility of retrieving the combined advantages of terrestrial Cellular networks and Satellite Systems. Cellular Systems provide high bandwidth, low latency data and voice services. On the other hand, use of Satellite Systems extends the geographical coverage of the overall network. MSS systems like Thuraya, ACeS, and INMARSAT etc. have contributed a lot in the development of hybrid network by coordinating with cellular vendors across the globe.

Main aim of an efficient MSS is to provide seamless radio hand over from terrestrial cellular system to satellite system as per the radio channel condition and availability. Since cellular and satellite radio channels behave differently in many aspects, separate considerations are required for both forms of wireless systems for simultaneous optimization. Satellite system faces multipath fading of signal strength based on the humongous distance that the signal has to travel and natural phenomenon of reflection, refraction, diffraction and scattering. In order to provide uniform connectivity, channel estimates based on shadowing effects and Doppler effects need to be addressed. Common Satellite mobile channel models noted in the literature are C.Loo model [3], Lutz model [4], and Corazza model [5]. Main aim of all satellite channel models is based on probabilistic description of the abnormality of the radio propagation.

In this paper, an introduction to various signal propagation mechanism affecting the signal is provided in section II.This is followed by some mitigation schemes which can be used to provide reliable MSS coverage to the mobile user.

II. SATELLITE LINK IMPAIRMENTS

To incorporate a low cost, high spectrally efficient wireless communication system, a complete description of all the propagation impairments is necessary. Satellite signal consists of a direct component, called the Line Of Sight (LoS), and multiple copies of this direct component known as multipath components. Situation is depicted in Figure 1. ITU-r [6] gives an exhaustive explanation of all the possible scenarios that the signal may encounter while its propagation. In [7], authors have modelled the received signal as

(
1

$$C(t) = A_0 e^{j(\omega_0 t + \varphi_0)} + \sum_{m=1}^{M} A_m e^{j(\omega_m t + \varphi_m)} + n(t) \qquad)$$

Where A_0, ω_0, are amplitude, Doppler shift and phase of the LOS component while summation part quantifies φ_0 the '*M*' multipath components and *n(t)* is the White Gaussian Noise.

According to equation (1), signal received by the mobile handset receiver comprises of a dominating LOS and several other components shifted in frequency and relative phase. Based on this fact and the fact that the signal has to cover a long distance various impairments in satellite signal path are discussed next.

A. *Free Space Path Loss*

FSL (Free Space Loss) is determined by the amount of distance that the signal has to travel and on the system's operating frequency. High operating frequency and larger distance results in higher losses. Even in theLoS component of received signal, FSL impacts the signal strength and mobile receiver front end must provide the legitimate amplification in

prime concern to the radio engineer to facilitate the anywhere, anytime connectivity supported by MSS SatCom.

Some techniques are suggested in this section for

In equation (2), σ denotes the standard deviation and 'r' denotes the envelope of the signal.

be used to mitigate the fades in Satellite communication link. Using more than one antenna each at transmitter and at the receiver brings multiple link establishments to the same mobile user into play. Designing an MIMO scheme is based on Space Time Coding (STC). As demonstrated in [15], additional dimension that comes into picture is the space which needs to be modelled in a similar way as time and frequency modelling in case of a SISO (Single Input Single Output) channel. A classical way adopted by several researchers is to model a wideband MIMO as being comprised of several narrowband SISO channels. Efficiency of such channel models depends upon the de-correlations among different fading paths available to multiple antennas. Spatially uncorrelated paths may be obtained using definite separation among multiple antennas in terms of wavelength at the frequency of operation. Key is to sample signals in spatial domain so as to generate multiple parallel channels as depicted in Fig.2. In order to achieve full benefit of MIMO model, certain trade-offs must be made between BER (bit error rate), system throughput, physical size of the receiver and amount of correlation between

improving the quality of reception.

A. *MIMO Techniques*

Multiple Input Multiple Output (MIMO) antenna techniques provide advantages of diversity and multiplexing gain that can

different antenna elements.

Effect of atmospheric attenuation on LoS based MIMO scheme is very well described in [15] which brings various interesting notes about the underlying technique. Under certain restrictions, Authors invoke the point that MIMO channel capacity is not effected by phase of the signal and that the capacity of SISO is almost half of the capacity obtained from a 2 X 2 MIMO scheme.

Limitation over the size of the mobile handset restricts the implementation of higher order of MIMO requiring multiple antennas with certain predefined separations. In case of MSS, the handset antenna needs to be made even larger in physical size due to absence of LoS component of signal. Satellite communication offers polarization as a means to combat this issue. Cross-polarized antenna arrays provide orthogonal or nearly orthogonal polarization (LHCP and RHCP or Horizontal and Vertical) fields which can be used for simultaneous reception of signals mitigating the multipath fade effects. This is shown in Fig. 2 (a) where one antenna at Satellite transmitter is utilized to create redundant paths. Another way to generate MIMO scheme is to use Spatial or Satellite Diversity where two Satellites can be shifted in the space to provision two distinguished links to the mobile user use. It can be noted from Fig.2 (b) that two Satellites use the same polarization to achieve diversity. Literature reveals the combination of polarization multiplexing and polarization diversity in order to double the effective amount of uncorrelated paths [16] the arrangement for it is shown in Fig. 2 (c). Here, two Satellites provide the required spatial diversity while the dual polarizations (LHCP and RHCP)per Satellites provisions a 2 X 4 MIMO scheme. A common difficulty faced in such implementations is of separating the multipath signal from the strong LOS component. System designer also needs to address issues like polarization mismatch between various radio paths and change in orientation of polarization due to Ionospheric propagation of the Satellite signal.

B. Fade Mitigation Techniques

Several FMTs (Fade Mitigation Techniques) have been utilized in the past depending upon the application for which they are developed. After performing a link budget calculations based on required coverage and availability, various techniques could be adopted for mitigating the impairments.

Downlink Power Control (DLPC) can be opted for combating rain attenuation by adjusting onboard power output. Onboard Beam Shaping (OBBM) [17] can be employed to utilize active antenna which allows spot beam power to adopt according to the propagation conditions.

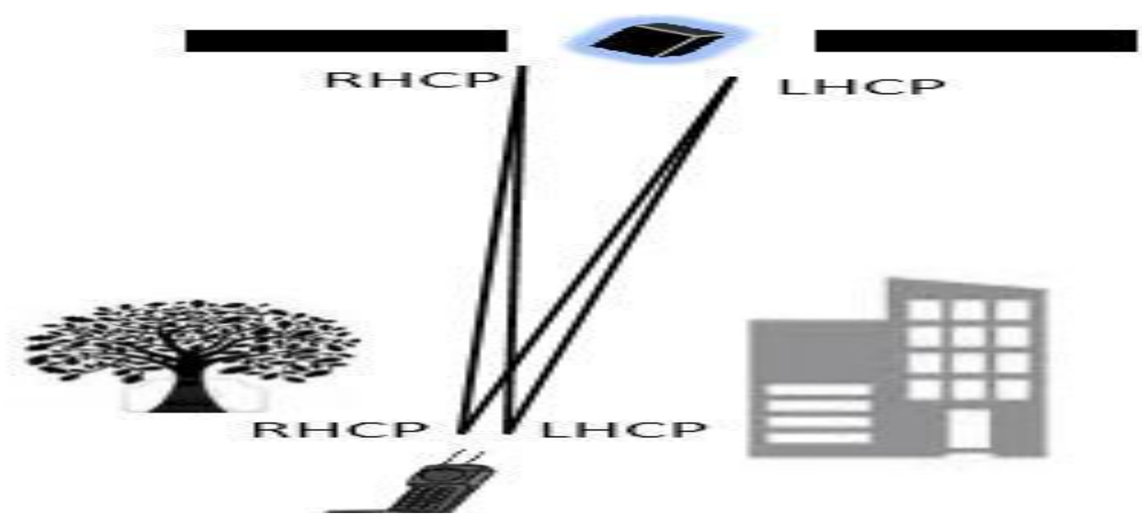

Figure 2(a) Polarization Diversity

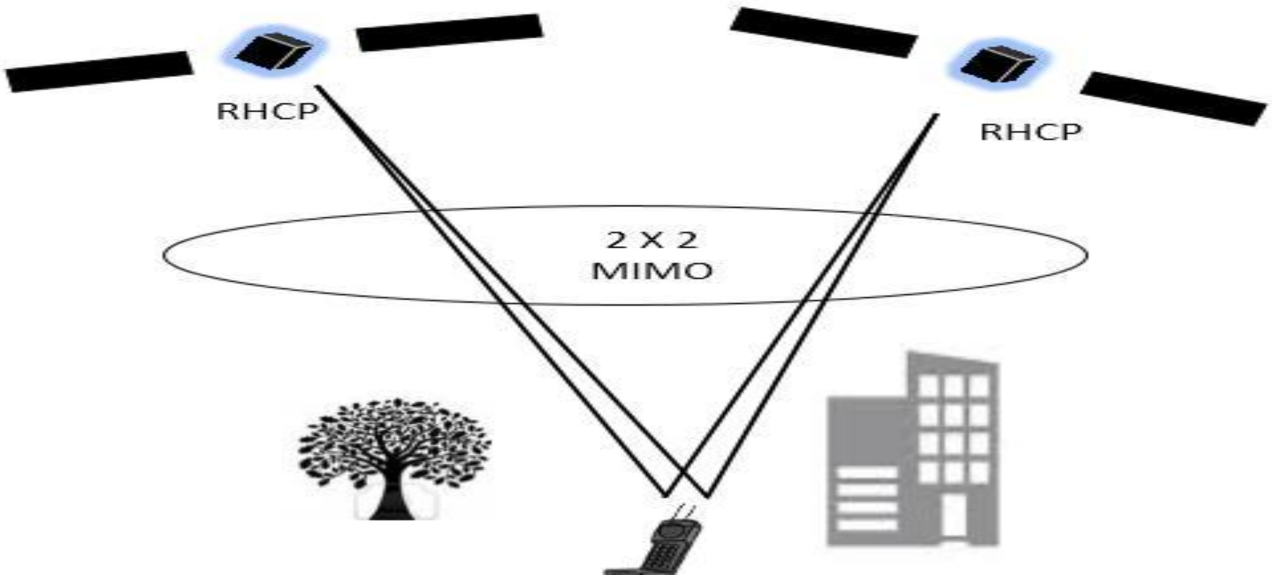

Figure 2(b) Satellite Diversity

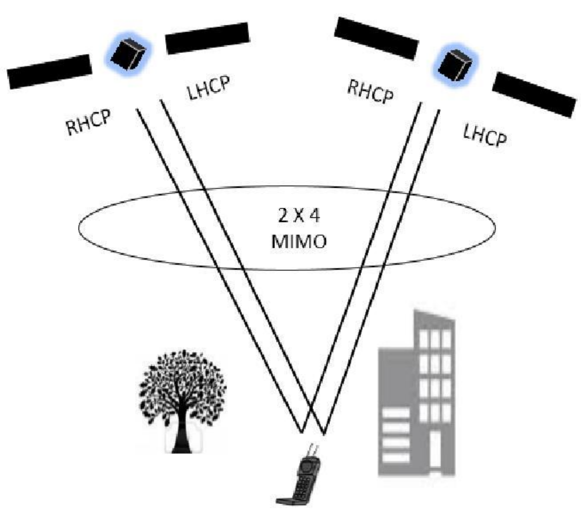

Figure 2(c) Dual Satellite/ Dual Polarization

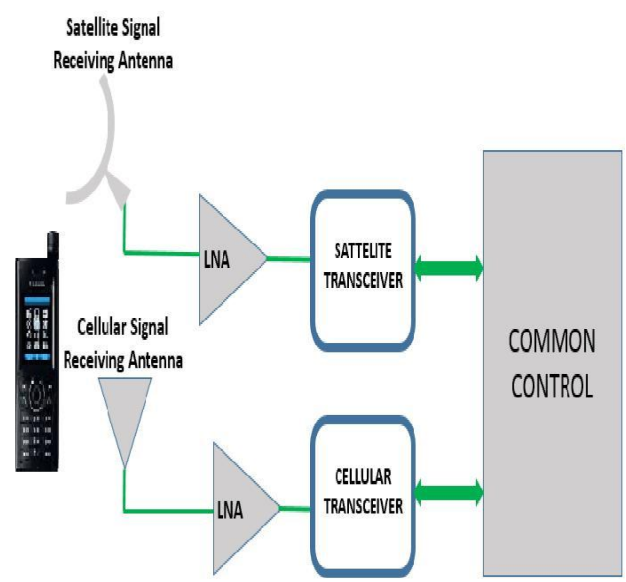

Figure 3 Hybrid Mobile Receiver Unit

Since both DLPC and OBBM techniques require downlink power modif1ication they can be used with effect in MSS where only mobile equipment is power constrained. Adaptive Modulation (AM) and Adaptive Coding (AC) are FMTs based on physical layer adaptability to the existing channel condition. In clear sky conditions, higher system capacity can be obtained from a given bandwidth using a spectrally efficient modulation scheme [18]. In an AM scheme, tropospheric degradations can be mitigated by falling over to aspectrally less efficient modulation scheme in order to make the physical layer more robust. AC consists of implementing a variable code rate matched to conditions in the radio propagation. As pointed out in the last section, Satellite Diversity (*SatD*) is yet another FMT that can be utilized to enhance reception quality and is very well discussed in [19]. It mainly comprises of optimizing the satellite constellation size in accord with the minimum elevation angle that the MSS will support.

C. Receiver RF Front End Optimization

Improvement in reception can be best optimized at the RF front end of the mobile receiver. MSS handset is designed to process signal both from terrestrial cellular systems and satellite. Due to matured MMIC (Monolithic Microwave Integrated Circuits) Technology, miniaturization of hardware has resulted into physically smaller equipment [20].A hybrid solution and an integrated solution has been noted.

In hybrid solution, both Satellite and cellular intelligence is housed in a single enclosure but they work separately as standalone receivers. In Integration based solution, both modems are grown over same wafer making the switching between two networks a smooth transition. Fig. 3 demonstrates the basic structure of a hybrid mobile receiver unit with separate antenna systems for Satellite and terrestrial cellular end. Satellite reception consideration deals with a weak signal arriving at the receiving antenna (or a collection of antennas in case of an MIMO scheme), the output of which is connected to Low Noise Amplifier (LNA). To improve the quality of reception, distance between antenna and LNA has to be optimized first. Second important aspect is the design of the LNA. The amount of noise of subsequent stages of the receiver following the LNA is reduced by the gain of the LNA, while noise contributed by it is directly added to the received signal [21]. This leaves two important considerations to the device engineer in high gain and small noise figure (NF) to be obtained simultaneously. Generally, these two parameters are opposing to obtain as the maximizing of one adversely effects the other. Gain maximization deals with minimization of VSWR (Voltage Standing Wave Ratio) which in turn depends upon impedance matching. Different optimization techniques have been reported for simultaneous gain maximization and NF minimization in [22] and [23].

Generally a dual LNA system is utilized for microwave amplification of receiving signal as shown in Fig. 4. This is one of the better way of achieving opposite requirements simultaneously. In such a scheme, the first of the two LNAs is designed with lowest possible NF for pre-amplification as it dominates the noise performance of the subsequent sections by the famous Friis Formula. Preamplifier should be placed as close to the antenna as possible and is sometimes fully integrated with it which gives rise to ‘active antenna’. Bandpass Filter (BPF) is used to reject the intermodulation products of the preamplifier. The output of the BPF is again amplified using an LNA, this time with superior gain. This scheme has been adopted by several satellite mobile service providers although an extra LNA might increase the cost of the equipment.

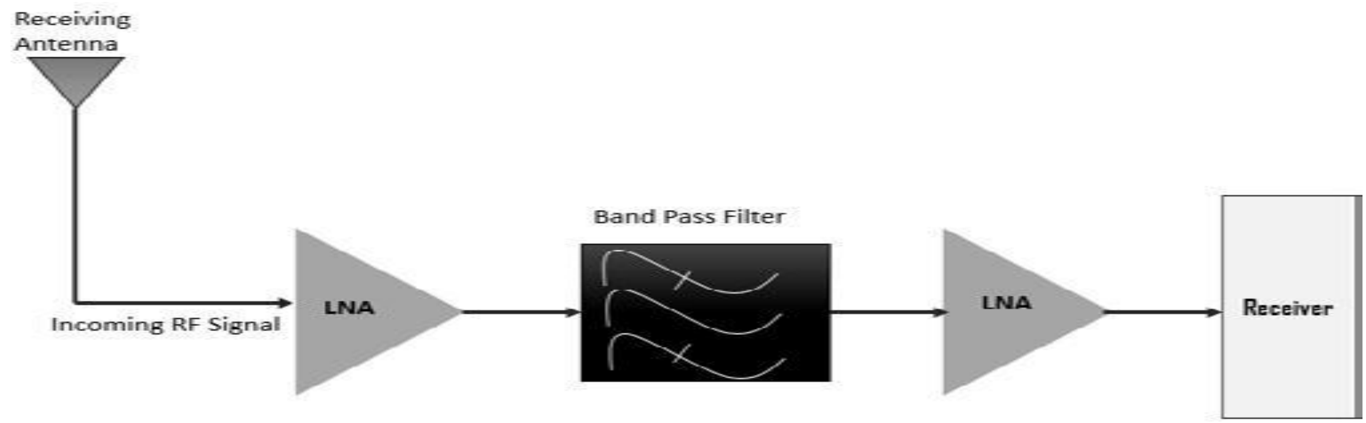

Figure 4 Dual LNA Receiver Front End

IV. CONCLUSION

In this paper, satellite radio channel impairments are presented and various means of improving the reception of MSS are discussed. Possibilities regarding the compensation of multipath and shadowing fades are noted. Methods discussed need to be implemented both at radio as well as at the device level in order to accommodate a robust communication system. Reception Improvement Techniques can be used individually or in combination to optimize the mobile user signal reception.

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