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Organized by: Department of Basic Science & Humanities,
Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex
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Educational Initiatives



CONTENT

Sl. No.	Content	Page No.
1	Inaugural lecture by the Chief Guest and Guest of Honor Prof. (Dr.) Bhaskar Gupta , Vice-Chancellor, Jadavpur University, India and P Inaugural lecture by Guest of Honor Prof (Dr.)Tanusri Saha-Dasgupta , Director, S. N. Bose National Centre for Basic Sciences	
Plenary Lectures		
2	"Ceramics for Space" Prof. (Dr.) M. R. Ajith	1
3	"Health Management of Oil-Filled Transformers-Why and How" Prof. (Dr.) Sivaji Chakravorti	3
4	"Recent Developments on Utilisation of Secondary Raw Materials in close Loop Materials Cycles" Prof. (Dr.) Sadhan Kumar Ghosh	4
5	Nanotechnology and Sensing Solutions for Water and Air Pollution Remediation" Padma Shri Prof (Dr) Ajoy Kumar Ray	9
Keynote Lectures		
6	"Structural Dynamics in the Solid State: Insights from Solvate Removal and Mechanical Grinding" Prof Jagadese J. Vittal	11
7	Development of Potential Strategies from Simple Ideas Prof. Nitin Chattopadhyay	13
8	"Advantages of Supramolecular Interactions for the Designing of Conductor to Superconductor" Prof. Chittaranjan Sinha	15
9	Engineered Polymer Nanoparticles for Cancer Drug Delivery Prof. Dibakar Dhara	19
10	"Helical Molecular Structure as a Key Molecular Design for the Photoluminescence of Rare Earth Complexes" Prof. Miki Hasegawa	22
11	"Developing efficient electrocatalysts for green energy applications" Prof. Kalyan Kumar Chattopadhyay	25
12	"Porphyrin Organization Towards Molecule-Based Functional Nanomaterials" Prof. Joe OTSUKI	27

International Conference on Recent Developments and Applications in Materials Science and Engineering
 RDAMSE 2025
 ISBN: 978-81-983133-3-1

13	"Chain-folding Regulated Hierarchical Assembly of Polyurethanes and Functional Materials" Prof. Suhrit Ghosh	29
14	"Natural Language Processing and Generation for Machine Understanding" Prof. Diganta Saha	31
15	"Bio-mulching Sheets: Applications and Prospects" Dr. Subhalakshmi Ghosh	34
16	"Natural Language Processing and Generation for Machine" Prof. Samiran Chattopadhyay	35
Special Lecture		
17	"Communicate collaborate and Construct" Dr. Subhabrata Mukhopadhyay	37
Invited Lectures		
18	"Facile Strategy of Producing Electrically Conducting Paste from a Unique Copper (II) Based Metal-Organic Complex" Dr. Barun Das	39
19	"Integration of Virtual Power Plants for a New Generation Smart Grid in Electricity Market" Dr. Bishaljit Paul	40
20	"Tuning Piezoelectric Responses Through Controlled Supramolecular Self-Assembly of Naphthalene Diimide Appended Peptide and Amino Acid Derivatives" Dr. Goutam Ghosh	42
21	"Possible Application of Doped Zinc Oxide Nanostructures as Cold Electron Gun" Dr. Diptonil Banerjee	44
22	"Science and Innovation: Transforming Oral Cancer Treatment" Dr. Pravesh Singh;	46
23	"CuBO ₂ : The New Age Efficient p-type Defectsite" Dr. Nirmalya Sankar Das	48
24	"Development of Arsenic Biofilter and Biofertilizer Using Isolated and Characterized Arsenic Hypertolerant, Plant Growth Promoting Strain of Enterobacter sp" Dr. Abhishek Basu	50
25	"Evolution of Aurivillius based Glass-Ceramics by Sol-Gel and Modified Solid State Process: Characterization & Properties" Dr. Soumya Mukherjee	52
26	"H ₂ Storage on Li decorated Triazole and Tetrazole Templates: Dr. Gourisankar Roymahapatra	55
27	"Controlling of Hazardous and Toxic Radioisotopes of Atomic Reactor on Glass Material" Dr. Tanmoy Das	57

Organized by: Department of Basic Science & Humanities,
 Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (SurTech), (Autonomous), Kolkata

28	"Mechanical Energy Driven Piezocatalysis Activity for Environmental Remediation" Dr. Subhajit Saha	61
Oral Presentation		
29	"The Genetic Landscape and the Immune Pathways Network of Ankylosing Spondylitis" Dipannita Barman, Sudeshna Sengupta, Nilasree Hazra, Malavika Bhattacharya	63
30	"Image Captioning using Deep Learning Technique A Novel Technique" Moloy Dhar, Suparna Biswas, Soumyajit Nandi, Soumyanil Dey, Mrinmoy Sen, Bidesh Chakraborty	65
31	"Ultra-Responsive Methane Sensing By 2d ZnO Nanoparticle Based MemS Gas Sensor-An Artificial Intelligence Based Study" Soumik Poddar, Suparna Biswas	67
32	"An Information Therapeutic Approach To Analyzing The Impact Of Meditation On Heart Rate Variability" Bidisha Dobe, Saurav Saha, Kaushik Sarkar, Sandhya Pattnayak, Arpita Barman Santra	69
33	"A Highly Selective Benzyl Dihydrazone Based Bisschiff Base Chemosensor For Colorimetric Detection Of Ni ²⁺ Ion And Turn-On Fluorometric Detection Of Ag ⁺ Ion In Semi-Aqueous Medium" Dishen Kumar and Goutam Kumar Patra	71
34	"Highly Sensitive, Cost-effective, Flexible, and Wearable Pressure Sensors Based on Perforated Graphene and Tissue Paper for Several Real-life Applications" Nabamita Chakraborty, Biswajit Das, Kalyan K. Chattopadhyay	72
35	"Mediqr - Integrated Patient And Doctor Management System" Sunit Jana, Sagnik Banerjee, Rakhi Biswas, Koushik Pal, Suparna Biswas	74
36	"Cost-Effective Nanomaterial For Bioethanol Production From Vegetable Peel: Waste-To-Green Energy" Debasmita Paul, Prantica Saha, Anushna Dutta, Anika Azmin, Namrata Patikar, Debalina Saha and Susmita Singh	76
37	"Market Clearing Mechanism Considering Power System Congestion Under The Influence Of Virtual Power Plant" Susovan Dutta, Bishaljit Paul, Barnali Kunda, Chandan Kumar Chanda	78
38	"An Efficient Technique for the diagnosis of Sleep Apnea by Integrating Wavelet Transform and Statistical Analysis" Subhankar Mukherjee, Suparna Biswas, Ayeek Chattopadhyaya, Soumik Poddar	80
39	"Enhancing Short-Term Electricity Demand Forecasting With Arima-Based Machine Learning Technique" Suwendu Mondal, Sayantan Chakraborty, Amitava Halder, Rumrum Banerjee, Prathita Roy, Roshan Bose, Rejaul Ali, Udisha Paik, Tanushree Mondal, Loveleena Paul	82
40	"Exploring Ni _{0.5} Co _{0.5} Fe ₂ O ₄ Solid Microspheres As A Supercapacitor Electrode Material" Priyanka Saha, S. Gaziz, R. Mondal, S. Kumar	84

41	Synthesis, Structural Characterization, Antimicrobial Activity And DNA Binding Study Of Sulfamethoxazole-2-Naphthol And Its Metal Complexes" Biswajit Das, Dipankar Das and Ipsita De	86
42	"A Review Paper Based On Temperature Effect Using Different MEMS Sensor" Mahua Raha Patra, Buddhadev Pradhan	88
43	"Phase Analysis, Optical And Electrical Properties Of Barium Bismuth Titanate By Modified Solid State Process" Soumya Mukherjee	90
44	"Mahali Tribe's Rice Beer 'Haria' - A Source Of Bioethanol" Pratima Mondal, Nilam Sing, Pratima Mondal, Mrinmay Mondal, Sintu Ganai, Puspall Mukherjee, Kalachand Mahali, Sanjay Roy,	92
45	"Magneto-Electrochemical Ammonia Synthesis: Boosting Nitrite Reduction Activity By The Optimized Magnetic Field Induced In Spin Polarized System" Koushik Mitra, A. Adalder, Dr. U. K. Ghorai	94
46	"Two Metal Site-Mediated Efficient C-N Coupling For Efficient Electrochemical Urea Synthesis" Sourav Paul and Uttam Kumar Ghorai	96
47	"Fe(TCNQ) ₂ Nanorod Arrays: An Efficient Electrocatalyst For Electrochemical Ammonia Synthesis Via The Nitrate Reduction Reaction" Nilmadhab Mukherjee and Uttam Kumar Ghorai	98
48	"Performance Analysis Of Dielectric Modulated Junctionless Trench Dg Ge Biosensors" Tanmoy Das, Swagata Bhattacharjee, Palasri Dhar, Sunipa Roy, Kristi Das	99
49	"Enhanced Extra Tree Classifier for Early Detection and Prevention of Heart Disease" Laboni Nayak, Subhash Mukherjee and Biplab Kanti Das	101
50	"Comparative Study Of Lipase Catalysed Esterification And Transesterification Processes To Produce Dilauryl Adipate" Sarbani Ganguly, Rupa Bhattacharyya, Susmita Karan and Sumit Nandi	103
51	"Synthesis, structural characterization, antimicrobial activity, DNA binding study of sulfamethoxazole-azo-7-hydroxy-4-methyl coumarin and its metal complexes" Dipankar Das, Biswajit Das and Ipsita De	105
52	"Heart Rate Estimation Using Facial Blood Volume Changes From Video Analysis" Neelam Haity, Adrija Ghosal, Rahul Kumar, Sayan Banerjee, Kaushik Sarkar	107
53	"A review on fabrication of Bio plastic and its application" Sayantana Mondal, Ananya Barman, Jit Chakraborty, Swagata Bhattacharjee, Prakrity Mukherjee, Arkopriyo Bhattacharya, Rupam Saha	109
54	"State of an Art for a Price Maker to Exercise Market Power in Virtual Power Plants" Dipu Mistry, Binoy Krishna Biswas, Sushovan Goswami, Reshmi Chandra, Bishaljit Paul, Chandan Kumar Chanda	111
Oral Presentation		

International Conference on Recent Developments and Applications in Materials Science and Engineering
RDAMSE 2025
ISBN: 978-81-983133-3-1

55	"A Wide-Bandwidth Circularly Polarized Dielectric Resonator Antenna with Integrated Cross-Slot and Annular-Slot Feed Mechanism" Debashis Das	113
56	"Automated Rice Variety Classification Using Optimized Convolutional Neural Networks" Vedant Kumar ,Sandip Haldar, Debashis Chakraborty , Shibam Mondal, Sayantani Chakraborty, Simanta Hazra	115
57	"A Comparative Analysis Of Vlsi And Embedded Systems: Technologies, Applications, And Future Trends" Gargee Sarkar, S. Bachhar , S.K. Biswas & J. Pandit	117
58	"Effect of Hydrothermal Reaction Time on the Dye Removal Efficacy of Graphitic Carbon Nitride Clusters" Karuna Chauhan, D. Banerjee, V. P. Shrivastava	119
59	"Design and Performance analysis of Capacitive Micro machined Ultrasonic Transducer with Hafnium Oxide dielectric Insulation Layer" Sk Sohel Ahamed, Moumita Pal, Pritam Chakraborty, Saradindu Panda , Biswarup Neogi	121
60	"Lumpy Skin Disease in Cattle: A Study Incorporating Chemical Treatment and Vaccination" Arghadip Roy, Banshidhar Sahoo , Seema Sarkar (Mondal)	122
61	"Photoluminescence Spectroscopic and Theoretical Investigations of the Interaction of Flavonoid Naringenin with Functionalized Graphene" Ayan Bera ,Sujoy Sarkar, Ananya Banik, Pooja Ghosh and Barun Das	124
62	"Electrical characteristics of Manganese doped Yttrium Chromite nanoparticles" Kripasindhu Kumar , Ranjita Sinha , Sandip Haldar , Soumen Basu , Ajit Kumar Meikap	126
63	"In search of most efficient antibacterial and antifungal Pyrazine derivatives towards future lead drug: an in-silico study" Joyita Dutta and Gourisankar Roymahapatra	128
64	"Sulfamethoxazole-azo-4-hydroxy-benzaldehyde, synthesis, structural characterization and DNA binding study of its" Ipsita De, Dipankar Das and Biswajit Das	130
65	"Zero -Emission, Zero- Budget, Zero-Waste: A Circular Program For Green Energy Generation And Agricultural Productivity Using Solar And Biomass Sources " Preeti G, Senthamarai Manogaranb and Kamalanathan Chandrana	132
66	"Multi-component reactions involving barbituric acid, urea and aldehyde in presence of yttrium nitrate with the biological efficacy study of the products against tyrosine-protein kinase: A combined experimental and theoretical aspects" Rahimasoom Reza Waleed S Alkhuraiji, Joydeep Chakraborty, Tanmoy Dutta, Rajesh Kumar Das, Abdul Ashik Khan	134
67	"Phase Analysis, characterization, optical properties of CCTO by modified solid state process" Saptarshi Mukherjee, Soumya Mukherjee, Souvik Chatterjee, Rajib Mondal	135
68	"Mechano-chemical activation to synthesize CuAlO ₂ : Phase Analysis, Structural and Optical Properties"	137

Organized by: Department of Basic Science & Humanities,
Dr. Sudhir Chandra Sur Institute of Technology and Sports Complex (SurTech), (Autonomous), Kolkata

	Apurba Sarkar, Soumya Mukherjee, Nandan Pakhira, Md Jamil Akhtar, Shibayan Roy	
69	"Industrial Application and innovative concepts of Adhesive bonding" Pritam Acharya Sen and Ghosh, T.K.	139
70	"Impact of Solute (Arsenic) Migration in Bengal Basin: Pulse Type Simulation" Tapan Paul	141
71	"Transforming Learning in AI for Energy Systems A Knowledge_Cognition_Application Paradigm with SDGs" Sulagna Adhikary, Adrija Guha, Sulagna Adhikary, Dr. Abhishek Bandyopadhyay	143
72	"Nano ZnO Induced Pvc For Mechanical Property Modification" Rupa Bhattacharyya, Sarbani Ganguly, Susmita Karan	145
73	"Structural Transformation Through Photochemical [2+2] Cycloaddition Of Metal Organic Coordination Compounds Impact The Electrical Conductivity" Basudeb Dutta	147
74	"Synthesis and Characterization of a Zn(II)-Based 2D Coordination Polymer for Schottky Diode Device Fabrication" Arnab Samanta	149
75	"Green Route Synthesis Of Pvcellulose Nanocomposites: Sustainable And Eco-Friendly Approaches" Susmita Karan, Rupa Bhattacharyya and Sarbani Ganguly	151
76	"Green Route Synthesis Of Pvcellulose Nanocomposites: Sustainable And Eco-Friendly Approaches" Chandan Santra, Abhijit Samanta	153
77	"An increase of efficiency as packaging by blending of recycled Polypropylene with rice husk extracted nanosilica and phthalated starch" Anirban Bhar, Aditi Roy, Divakar Pamanji, Priyasi Bhangar, Oliva Roy, Bimal Das, Biswajit Kamila, Deepshikha Datta, Chhandam Chakraborty, Akshay Kumar Dey, Arindam Roy	155
78	"Optimal scheduling through deterministic and stochastic approach in Virtual Power Plants" Priyanjali Mukherjee, Subhamoy Dey, Sushovan Goswami, Reshmi Chandra, Bishaljit Paul	157
79	"Formulation of General Estimation Strategy for Population Variance under Two-Phase Cluster Sampling" Arnab Bandyopadhyay, Mithu Dey (Sarkar) and P. Parichha	159
Poster Presentation		
80	"Production Of Biofuel From Algal Biomass By Aqueous Phase Reforming" Taanisha Mukhopadhyay, Gourisankar Roymahapatra	165
81	"VLS Deposition Of Cu ₂ Se1-X: Electrocatalyst For Hydrogen Evolution" Supratim Maity, Shrabani Ghosh, Biswajit Das, Madhupriya Samanta, Kalyan Kumar Chattopadhyaya	167

82	"Microstructural ZnFe ₂ O ₄ : A Promising Electrode Material for Advanced Supercapacitors" Sujauddin Gazi, P. Saha¹, K. Sarkar, R. Mondal, S. Kumar,	169
83	"Observation of Non-linear Optical Properties of a Mott Insulator Sr ₂ CuO ₃ Through Spatial SelfPhase Modulation" Bhaswati Das, Nabamita Chakraborty, Piyali Dey, Biswajit Das, Subrata Sarkar and Kalyan K. Chattopadhyay	171
84	"Morphologically Tuned ZnSnO ₃ for Dye Selective Photocatalytic Degradation under UV Irradiation" Suvra Pal, Nirmalya Sankar Das and Kalyan Kumar Chattopadhyay	173
85	"Photocatalytic And Cold Emission Properties Of Morphology Altered Bga ₂ o ₃ Nanostuctures" Brahmi Das, and Kalyan K. Chattapadhyay	175
86	"Enhanced Electron Field Emission Properties Of Rgo/Co ₃ O ₄ Nanocomposite" Partha Hajra, Biswajit Das, Supratim Maiti, Nirmalya Sankar Das, Kalyan Kumar Chattopadhyay	177
87	"Isolation And Characterization Of Arsenic Hypertolerent Bacteria From Arsenic Contaminated Groundwater Of Murshidabad District." Manali Biswas and Abhishek Basu	179
88	"Sulfamethoxazole-Azo-3-Chloro Phenol, Synthesis, Structural Characterization And DNA Binding Study Of Its." Dipankar Das, Biswajit Das and Ipsita De	180

Oral Presentation – OP-10

An Efficient Technique for the diagnosis of Sleep Apnea by Integrating Wavelet Transform and Statistical Analysis

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INTRODUCTION

Detection of sleep apnea is a challenging area of health research. Electrocardiogram (ECG) signals are utilized for clinical findings related to sleep apnea. The electrocardiogram, or ECG, is a voltage versus time (ECG) signals have been analyzed to detect the sleep apnea diseases.

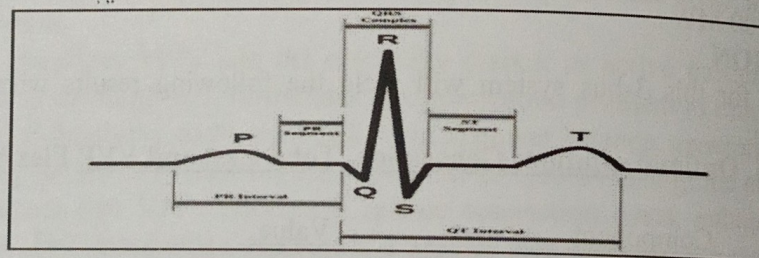


Fig. 1. Signal of ECG [2]

MATHEMATICAL TOOLS USED FOR SLEEP APNEA DETECTION

In this analysis, CWT and DWT based statistical analysis has been used to detect the obstructive sleep apnea and DWT is applied to extricate the time-frequency information. ECG waveform is inherently varying. CWT and DWT is compatible to extract the information from a non-stationary or varying signal. The signal $x(t)$ can be expressed as,

$$X_{\omega}(c, d) = \frac{1}{|c|^{\frac{1}{2}}} \int_{-\infty}^{\infty} x(t) \varphi^*\left(\frac{t-d}{c}\right) dt \quad (1)$$

2 Proposed Method

In this proposed method, ECG signal of healthy person, sleep apnea patient were considered. Collected ECG signal is passed through a SG FIR filter for de-noising and then denoised signals have been normalized for analysis.

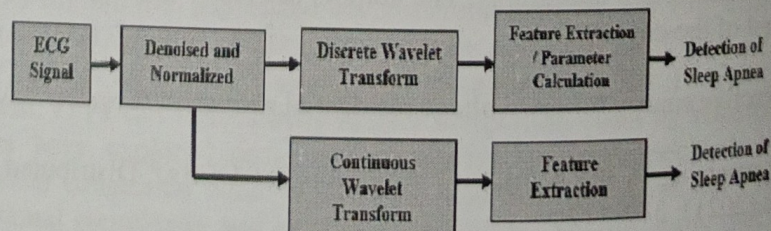




Fig. 2. Proposed Method Flow Diagram

and DWT based statistical analysis are applied on pre-processed ECG signals. The diagnosis procedure of sleep apnea is depicted in Fig. 2.

RESULTS AND DISCUSSION

CWT is used here for the diagnosis of sleep apnea. CWT has been done on the captured signals (ECG) of healthy person and sleep apnea patient. Fig. 3 and Fig. 4 are used to depict the CWT result (de-noised ECG signal) of healthy person, sleep apnea patient respectively. In Table 1, mean values (from detail and approximation coefficients) are given of a normal healthy person

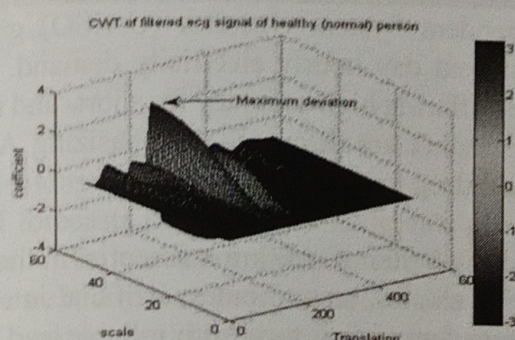


Fig. 3. CWT Of De-Noised and Normalized Healthy Person's ECG

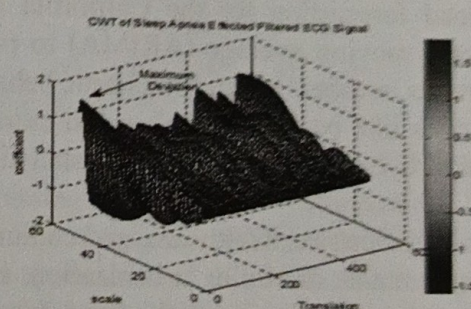


Fig. 4. CWT Of De-Noised and Normalized Sleep Apnea Patient's ECG

TABLE 1. MEAN VALUES OF APPROXIMATION AND DETAIL COEFFICIENTS OF HEALTHY PERSON

Decomposition level (DWT)	Results of mean values from approximation coefficients	Mean values of detail coefficients
1	0.050197	-3.40E-23
2	0.050197	-1.05E-08
3	0.050197	2.74E-08
4	0.0502	-3.02E-06
5	0.050207	-7.36E-06
6	0.049592	0.000615
7	0.048949	0.000643
8	0.046104	0.002844
9	0.042817	0.003287

CONCLUSION

In this work, electrocardiogram signal has been analyzed to detect sleep apnea disease. CWT, DWT based statistical parameter has been computed from ECG signals of sleep apnea patient and healthy person. In CWT, distinct features have been extracted for sleep apnea patient over normal healthy person. In DWT based standard deviations and mean value analysis, clear differences have been noticed for both the coefficients (approximation, detail). Clear deviations were detected for standard deviations and mean values (approximation coefficients) in both the cases. These results can be utilized for diagnosis of sleep apnea.