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Name: **Aurobinda Routray**

Gender: **Male**

Date of Birth: **26.06.1968**

Designation & Affiliation: **PROFESSOR**
DEPARTMENT OF ELECTRICAL ENGINEERING,
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Qualifications:

Post Doc (Purdue University)

PhD. (NIT Rourkela)

M.Tech (IIT Kanpur)

BSc. Engg. (NIT Rourkela)

Professional Experience 22 Years: 13 years at IIT KGP + 1 year Purdue + 8yrs at NIT ROU

Awards (Honours)

- Samsung GRO Award 2012
- State Young Scientist Award 1999
- BOYSCAST fellowship 2003-2004
- First place in "Competition on Biometrics via Eye Movements" organized by IEEE Seventh International Conference on Biometrics: Theory, Applications and Systems 2015
- Only presentation from outside USA allowed on "An Overflow-Free Fixed-point Singular Value Decomposition Algorithm for Dimensionality Reduction of Hyperspectral Images," at NASA HypSIRI Science Symposium 2015

List of Relevant Publications**Journals**

1. S. Sahoo, **A. Routray**, "A Novel Method of Glottal Inverse Filtering," *IEEE/ACM Transactions on Audio, Speech, and Language Processing*, vol. 24, no.7, pp. 1230-1241, 2016.
2. S. L. Happy, P. Patnaik, A. Routray, and R. Guha, "The Indian Spontaneous Expression Database for Emotion Recognition," *IEEE Transactions on Affective Computing.*, vol. PP, no. 99, pp. 1-1, 2015.
3. A. Dasgupta, S. Chakraborty, **A. Routray**, "A Two-Stage Framework for Denoising Electrooculography Signals," *Biomedical Signal Processing and Control, Elsevier*, (Accepted with minor revision), 2016.
4. A. George and A. Routray, "A Fast and Accurate Algorithm for Eye Localization for Gaze Tracking in Low Resolution Images," *IET Computer Vision*, Mar. 2016.
5. A Basu, A Routray, R Mukherjee, S Shit. Infrared imaging based hyperventilation monitoring through respiration rate estimation. *Infrared Physics and Technology* (2016) 77, 382-390.
6. S.S. Anand, **A. Routray**, B.S. Das, S. Ahmad, "Hyperspectral image pre-processing with bilateral filter for improving the classification accuracy of support vector machines," *Journal of Applied Remote Sensing*, vol. 10, no. 2, 2016.

7. A. George, **A. Routray**, "A score level fusion method for eye movement biometrics," *Pattern Recognition Letters*, 2015
8. B. Kabi, S. S. Anand, R. Mohanty, **A. Routray**, B. S. Das, "Avoiding Overflow in Fixed-Point Eigenvalue Decomposition Algorithm for Dimensionality Reduction of Hyperspectral Images," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 2016.
9. S L Happy and **A. Routray**, "Automatic Facial Expression Recognition Using Features of Salient Facial Patches," *IEEE Transactions on Affective Computing.*, vol. 6, no. 1, pp. 1-12, 2015.
10. R. Mukherjee, M. Saha, **A. Routray**, C. Chakraborty, "Nano-Scale Surface Characterization of Human Erythrocytes by Atomic Force Microscopy, A Critical Review," in *IEEE Transactions on Nanobioscience* 99., vol. 14, no. 6, 2015.
11. A Sengupta, S Datta, S Kar, **A. Routray** , "EEG Synchronization and Brain Networks: A Case Study in Fatigue," *International Journal of Biomedical and Clinical Engineering*, vol. 4, no 2, 2015.
12. A. Sengupta, **A. Routray**, S. Kar, "Analysis of Variation of Fatigue using Visibility Graph Similarity-based Brain Networks," *Australasian Medical Journal*, vol.7, no. 2, pp 83-135, 2014.
13. A. Dasgupta, A. George, S. L. Happy, and **A. Routray**, "A Vision-Based System for Monitoring the Loss of Attention in Automotive Drivers," *IEEE Transactions on Intelligent Transportation Systems*, vol. 14, no. 4, pp. 1–14, 2013.
14. S. Kar, **A. Routray**, "Effect of Sleep Deprivation on Functional Connectivity of EEG Channels," *Transactions on Systems, Man, and Cybernetics: Systems, on*, vol. 43, no. 3, pp. 666 – 672, 2013.
15. T. Pradhan, **A. Routray**, and B. Kabi, "Comparative Evaluation of Symmetric SVD Algorithms for Real-Time Face and Eye Tracking", *Matrix Information Geometry. Springer Berlin Heidelberg*, pp. 323-340, 2013.
16. A. Dasgupta, A. George, S. L. Happy, **A. Routray**, and T. Shanker, "An on-board vision based system for drowsiness detection in automotive drivers," *Int. J. Adv. Eng. Sci. Appl. Math.*, vol. 5, no. 2–3, pp. 94–103, Aug. 2013.
17. S. Kar, **A. Routray**, B. P. Nayak, "Functional network changes associated with sleep deprivation and fatigue during simulated driving: validation using blood biomarkers", *Clinical Neurophysiology*, vol. 122, no. 5, pp. 966-974, 2011.
18. S. Kar, M. Bhagat, **A. Routray**, "EEG Signal Analysis for the Assessment and Quantification of Driver's Fatigue", *Elsevier Transportation Research Part F*, vol.13, pp. 297-306, 2010.
19. A.B. Kandali, **A. Routray**, T. K. Basu, "Cross-Lingual Vocal Emotion Recognition in Five Native Languages of Assam Using Eigenvalue Decomposition", *Pattern Recognition and Machine Intelligence, Lecture Notes in Computer Science*, pp. 519-524, 2009.
20. A.B. Kandali, **A. Routray**, T. K. Basu, "Vocal emotion recognition in five native languages of Assam using new wavelet features", *International Journal of Speech Technology*, pp. 1-13, 2009.
21. T. Pradhan, B. Kabi, **A. Routray**, "Fixed-Point Hestenes Algorithm for Singular Value Decomposition of Symmetric Matrices" in *ISI/SCOPUS Book (Hard-Copy) (Indexed in ISI, ELSEVIER, SCOPUS, ACM, PubMed, Zentralblatt MATH, British Library, EBSCO, SWETS, EMBASE, CAS)*, 2013.
22. B. P. Nayak, C. K. Murthy, Y. Tatebayashi, **A. Routray**, "Assessment of psychomotor performance in α CaMK-II-4R tau mice: an insight into human tauopathies", *Future Neurology*, vol. 7, no. 6, pp. 773-783, 2012.
23. M. N. Mohanty, **A. Routray**, "Estimation of autocorrelation space for classification of bio-medical signals", In *Swarm, Evolutionary, and Memetic Computing*, pp. 697-704, Springer Berlin Heidelberg, 2012.
24. D. Patil, N. Das, **A. Routray**, "Implementation of Fast-ICA: A Performance Based Comparison Between Floating Point and Fixed Point DSP Platform", *Measurement Science Review*, vol. 11, no. 4, 2011.
25. S. Gupta, **A. Routray**, A. Mukherjee, "A New Method for Edge Extraction in Images using Local Form Factors", *Int Journal of Computer Applications*, vol.11, no.2, pp. 15-22, 2011.
26. K. Senapati, **A. Routray**, "Comparison of ICA and WT with S-transform based method for removal of ocular artifact from EEG signals", *J Biomed SciEng*, vol.4, no. 5, pp. 341-351, 2011.

27. K. Senapati, S. Dhubia, **A. Routray**, "Blind deconvolution of seismic signals in time and frequency domain: A study on 2004 sumatra earthquake", *International Journal of Signal Processing, Image Processing and Pattern Recognition*, vol. 4, no. 1, pp. 29-47, 2011.
28. M. N. Mohanty, **A. Routray** P. Kabisatpathy, "Optimisation of features using evolutionary algorithm for EEG signal classification", *International Journal of Computational Vision and Robotics*, vol. 3, no. 1, pp. 297-310, 2010.
29. M. N. Mohanty, A. Kumar, **A. Routray**, P. Kabisatpathy, "Evolutionary algorithm based optimization for power quality disturbances classification using support vector machines", *International Journal of Control, Automation and Systems*, vol. 8, no. 6, pp. 1306-1312, 2010.
30. Niva Das, **A. Routray**, and Pradipta Kishor Dash, "A robust H^∞ learning approach to blind separation of slowly time-varying mixture of acoustic electromechanical signals", *Mechanical Systems and Signal Processing*, 2009.
31. M. Mohanty, A. Mishra, **A. Routray**, "A non-rigid motion estimation algorithm for yawn detection in human drivers", *International Journal of Computational Vision and Robotics*, 1(1), 89-109, 2009.

Publications in Conference Proceedings

1. A. George, **A. Routray**, "Real-time Eye Gaze Direction Classification Using Convolutional Neural Network," *IEEE International Conference on Signal Processing and Communication, SPCOM*, 2016.
2. A. Dasgupta, A. Mandloi, A. George, **A. Routray**, "An Improved Algorithm for Eye Corner Detection," *IEEE International Conference on Signal Processing and Communication, SPCOM*, 2016.
3. A. Sengupta, A. Tiwari, A. Chaudhuri, **A. Routray**, "Analysis of loss of alertness due to cognitive fatigue using Motif Synchronization of EEG records", *38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBC*, 2016
4. A. Chaudhuri, A. Dasgupta, S. Chakroborty, **A. Routray**, "A Low-Cost, Wearable, Portable EOG Recording System," *IEEE Int. Conf. on Sys. Med. Bio.*, 2016
5. A. Dasgupta, S. Chakroborty, A. Chaudhuri, **A. Routray**, "Evaluation of Denoising Techniques for EOG signals based on SNR Estimation," *IEEE Int. Conf. on Sys. Med. Bio.*, 2016
6. A. Chaudhuri, A. Dasgupta, S. Chakroborty, "Determination of Ocular Gaze Fixation Point: An EOG Based Approach," *IEEE Int. Conf. on Sys. Med. Bio.*, 2016.
7. B. Kabi, S.S. Anand, R Mohanty, **A. Routray** , B. S. Das, A. Mohanty, "An Overflow-Free Fixed-point Singular Value decomposition Algorithm for Dimensionality Reduction of Hyperspectral Images," in *NASA HypSIRI Science Symposium*, 2015.
8. A. Basu, **A. Routray**, S. Shit and A. K. Deb, "Emotion Recognition from Facial Thermal Image based on Fused Statistical Feature and Multi-Class SVM," in *IEEE India International Conference, (INDICON)*, pp. 1-5, 2015
9. A. Basu, R. Mukherjee, **A. Routray** and A. K. Deb, "Increased core body temperature is accompanied by altered metabolic state during brief session of guided Kriya Yoga meditation: A Thermographic Study" in *Quantitative Infrared Thermography Asia (QIRT-Asia)*, Mamallapuram, 2015
10. A. Basu, **A. Routray** and A. K. Deb, "Human Emotion Recognition from Facial Thermal Image using Histogram based Features and Multi-Class Support Vector Machine," in *Quantitative Infrared Thermography- Asia (QIRT-Asia)*, Mamallapuram, 2015
11. S L Happy, and **A. Routray**. "Robust facial expression classification using shape and appearance features," *IEEE Eighth International Conference on Advances in Pattern Recognition (ICAPR)*, 2015.
12. B. Kabi, **A. Routray** and R. Mohanty, "Fixed-Point Singular Value Decomposition Algorithms with Tight Analytical Bounds", in *SIAM Conference on Applied Linear Algebra (LA15)*, 2015.
13. L. Shaw, S. Mishra, and **A. Routray**, "Generalized orthogonal partial directed coherence as a measure of neural information flow during meditation", *Conference Proceedings, ICAME*, pp. 137-148, 2015.
14. L. Shaw and **A. Routray**, "Efficacy of Adaptive Directed Transfer Function for Neural Connectivity Estimation of EEG Signal During Meditation", *Signal Processing and Integrated Networks (SPIN)*, 2015 *IEEE conference proceedings.*, pp.198 – 202, 19-20 Feb. 2015.

15. A. Sengupta, S. Dutta, S. Kar, and **A. Routray**, "EEG Synchronization and Brain Networks: A Case Study in Fatigue," *MEDCOM*, 2014.
16. A. Sengupta, **A. Routray**, S. Kar, "Estimation of Fatigue in Drivers by Analysis of Brain Networks" in *EAIT 2014*
17. A. Sengupta, S. Dutta, S. Kar, **A. Routray**, "Analysis of Fatigue using EEG State-Space Analysis", *IEEE Annual India Conference (INDICON)*, *INDICON*, 2014.
18. B. Kabi, R. Mohanty, S. Sahoo, **A. Routray**, "An analytical framework for area and switching power optimization of a fixed-point FFT algorithm", by in *IEEE Students' Technology Symposium (TechSym)*, 2014.
19. B. Kabi, S. Sahoo, A. K. Samantaray, **A. Routray**, "Floating to Fixed-point Translation with its Application to Speech-based Emotion Recognition", *IEEE Fourth International Conference of Emerging Applications of Information Technology (EAIT)*, 2014.
20. A. Sengupta, **A. Routray**, S. Kar, "Complex brain networks using Visibility Graph synchronization", *IEEE INDICON*, pp. 1-4, 2013.
21. A. Sengupta, **A. Routray**, S. Kar, "Analysis of Variation of Fatigue using Visibility Graph Similarity-based Brain Networks" Poster presentation at EMS-IEH, AIIMS, October 2013, Abstract published in *Australasian Medical Journal*, Vol.7, No. 2, pp 83-135, 2014
22. A. Chaudhuri, S. Nayak, **A. Routray**, "Use of Data Driven Optimal Filter to obtain Significant Trend present in Frequency Domain Parameters for Scalp EEG Captured during Meditation" , *IEEE Students' Technology Symposium*, 2014
23. B. Kabi, R. Mohanty, S. Sahoo and **A. Routray**, "An Analytical Framework for Area and Switching Power Estimation of a Fixed-point FFT Algorithm," *IEEE Student's Technology Symposium, TechSym*, 2014
24. S. Gupta, A. Dasgupta, and **A. Routray**, "Analysis of Training of Parameters in Haar-like Features to Detect Human Faces," in *IEEE International Conference on Image Information Processing*, Shimla, India, 2011.
25. M. Singhvi, A. Dasgupta, **A. Routray**, "A Real Time Algorithm for Detection of Spectacles Leading to Eye Detection," in *IEEE Proceedings of 4th International Conference on Intelligent Human Computer Interaction*, Kharagpur, India, 2012
26. A. Chaudhuri, A. Dasgupta, **A. Routray**, "Video and EOG Based Investigation of Pure Saccades in Human Subjects," in *IEEE Proceedings of 4th International Conference on Intelligent Human Computer Interaction*, Kharagpur, India, 2012
27. S. L. Happy, A. Dasgupta, A. George, **A. Routray**, "A Video Database of Human Faces under Near Infra-Red Illumination for Human Computer Interaction Applications," in *IEEE Proceedings of 4th International Conference on Intelligent Human Computer Interaction*, Kharagpur, India, 2012
28. S L Happy, A. Dasgupta, P. Patnaik, and **A. Routray**, "Automated Alertness and Emotion Detection for Empathic Feedback during E-Learning," in *IEEE International Conference on Technology for Education*, Kharagpur, India, 2013.
29. BP Nayak, S Kar, **A. Routray**, AK Padhi, "A biomedical approach to retrieve information on driver's fatigue by integrating EEG, ECG and blood biomarkers during simulated driving session", in *Intelligent Human Computer Interaction (IHCI), 4th International Conference on*, 2012.
30. SL Happy, A George, **A. Routray**, "A real time facial expression classification system using Local Binary Patterns", in *Intelligent Human Computer Interaction (IHCI), 4th International Conference on*, 2012.
31. S Gupta, **A. Routray**, "Estimation of Saccadic Ratio from eye image sequences to detect human alertness", in *Intelligent Human Computer Interaction (IHCI), 4th International Conference on*, 2012.
32. T Pradhan, AN Bagaria, **A. Routray**, "Measurement of PERCLOS using Eigen-eyes, in *Intelligent Human Computer Interaction (IHCI), 4th International Conference on*, 2012.
33. A Chaudhuri, A Routray, S Kar, "Effect of sleep deprivation on estimated distributed sources for Scalp EEG signals: A case study on human drivers, in *Intelligent Human Computer Interaction (IHCI), 4th International Conference on*, 2012.

34. **A. Routray**, S Kar, "Classification of brain states using principal components analysis of cortical EEG synchronization and HMM", in *Acoustics, Speech and Signal Processing (ICASSP), IEEE International Conference on*, pp. 641-644, 2012.
35. R Mohanty, **A. Routray**, "Advanced virtual embedded system laboratory", in *IEEE Interdisciplinary Engineering Design Education Conference (IEDEC)*, pp. 92-95, 2012.
36. A. Acharya, S. Kar, **A. Routray**, "Phase synchronization based weighted networks for classifying levels of fatigue and sleepiness", in *Systems in Medicine and Biology (ICSMB), International Conference on*, Pages 265-268, 2010.
37. K. Senapati, S. Kar, **A. Routray**, "A new technique for removal of ocular artifacts from EEG signals using S-transform", in *Systems in Medicine and Biology (ICSMB), in International Conference on*, Pages 113-116, 2010.
38. **A. Routray**, A. Rajaguru, S. Singh, "Data reduction and clustering techniques for fault detection and diagnosis in automotives", in *Automation Science and Engineering (CASE), in IEEE Conference on*, Pages 326-331, 2010.
39. L.S. Dhupati, S. Kar, A. Rajaguru, **A. Routray**, "A novel drowsiness detection scheme based on speech analysis with validation using simultaneous EEG recordings", in *Automation Science and Engineering (CASE), IEEE Conference on*, page 917-921, 2010.
40. S. Dhar, T. Pradhan, S. Gupta, **A. Routray**, "Implementation of real time Visual Attention Monitoring algorithm of human drivers on an embedded platform", in *Students' Technology Symposium (TechSym), IEEE*, page 241-247, 2010. **(Best Paper Award)**
41. S. Gupta, S. Kar, **A. Routray**, "Fatigue in human drivers: A study using ocular, Psychometric, physiological signals", in *Students' Technology Symposium (TechSym), IEEE*, page 234-240, 2010.
42. A. B. Kandali, **A. Routray**, T K Basu, "Emotion recognition from Assamese speeches using MFCC features and GMM classifier", in *TENCON 2008 IEEE Region 10 Conference*, page 1-5, 2008.
43. **A. Routray**, K. B. Mohanty, "A fast edge detection algorithm for road boundary extraction under non-uniform light condition", in *Information Technology, (ICIT). 10th International Conference on*, page 38-40, 2007.

Patents filed/granted with details

- A System for Real Time Assessment of Level of Alertness: Published (Ref: 634/KOL/2013)
- An Electromagnetic Device based system for Fault Detection and Identification in Rotating Mechanical Components: Published (Ref: 803/KOL/2005)
- Event-Driven Data Mining Method for Improving Fault Code Settings and Isolating Faults: (Ref: US 2012/0035803 A1) US patent
- A Real-Time System for Object Detection and Recognition with Machine Learning: Published (Ref: 647/Kol/2013)
- Real-time On Board Driver Drowsiness Monitoring System: Published (Ref: 660/ KOL /2010)

Books published /Chapters contributed

1. Numerical Linear Algebra in Signals, Systems and Control by P V Dooren, S P Bhattacharyya, R H Chan, V Olshevsky, **A. Routray** (Springer, 2011)
2. Comparative Evaluation of Symmetric SVD Algorithms for Real-Time Face and Eye Tracking by T. Pradhan, **A. Routray**, and B. Kabi, Matrix Information Geometry. Springer Berlin Heidelberg, 323-340. (2013)

PhD supervision

2008-2009	2
2009-2010	3
2010-2011	4
2011-2012	9
2012-2016	23

Sponsored projects as PI

Title	Sponsoring agency	Duration	Status
THE EFFECT OF MEDITATION, PRANAYAM AND MEDITATIVE SOUNDS ON THE COGNITIVE AND EMOTIONAL PERFORMANCE OF HUMAN BRAIN: A STUDY USING AN INTEGRATED SIGNAL AND IMAGE APPROACH (CEH)	MHRD , NEW DELHI	2013-16	On going
DEVELOPMENT OF A PORTABLE EMBEDDED SYSTEM FOR HUMAN MONITORING/SIGNALS & SYSTEMS FOR LIFE SCIENCES (HLS)	MHRD , NEW DELHI	2014-17	On going
DESIGN & DEVELOPMENT OF AN ON-BOARD INTELLIGENT EMBEDDED PLATFORM FOR DETECTION OF WEAK FAILURE MODES AND PROGNOSIS OF SEVERE FAULTS IN LOCOMOTIVES AND ASSOCIATED EQUIPMENT (AOW)	Research Designs & Standards Organisation (RDSO) Ministry of Railways,	2012-2016	On going
DEVELOPMENT OF A NON-OBTRUSIVE ALERTNESS ASSESSMENT SYSTEM FOR AIRCRAFT PILOTS FOR A GO/NO-GO ASSESSMENT (AGG)	Defence Institute of Physiology and Allied Sciences, DRDO	2015-16	On going
REAL TIME EMBEDDED SYSTEMS LAB (VLS/13)	MHRD , NEW DELHI	2010-17	On going
FAST FIXED POINT ALGORITHMS FOR IDENTIFYING ALERTNESS AND EMOTIONS (FIA)	Samsung Electronics Co.Ltd	2012-13	Completed
DESIGN OF AN EMBEDDED SYSTEM FOR ON-BOARD ASSESSMENT OF LEVEL OF ALERTNESS IN HUMAN DRIVERS (ALA)	DeitY, Govt. of India	2010-13	Completed
DEVELOPMENT OF AN INTEGRATED ALERTNESS ASSESSMENT SYSTEM FOR AIRCRAFT PILOTS FOR A GO/NO-GO ASSESSMENT (APN)	Defence Institute of Physiology and Allied Sciences, DRDO	2014-15	Completed
INTEGRATED VEHICLE HEALTH MANAGEMENT (IVHM) FOR AUTOMOTIVE ENGINE APPLICATIONS (AEA)	Aeronautical Development Agency, Ministry of Defence, Govt. of India	2010-14	Completed