

# **Curriculum Vitae**

**Dr. (Cdr) Arnab Das**

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## **Present Position:**

Director, Maritime Research Centre (MRC) at the Indian Maritime Foundation (IMF), Pune.

Visiting Professor at the Defence Institute of Advanced Technology.

Managing Director, Nirdhwani Technology Pvt Ltd.

**Previous Positions:** Research Fellow at the Acoustic Research Lab, National University of Singapore 2015-2016.

Adjunct Faculty at Indian Institute of Technology, Delhi (2014-2015) and Defence Institute of Advance Technology, Pune (2013-2015), India.

Served the **Indian Navy** wef 1994 till 2015 and held multiple assignments as below:

**2013-Jul 2015:** Faculty/Directing Staff at Military Institute of Training, DRDO.

**2009-2012:** Project Manager (R&D), Underwater Ranges, Goa, Defence Research and Development Organization. Charged with the responsibility of Acoustic and Magnetic Stealth Analysis of Naval Ships and Submarines. Deployment, maintenance and Up-gradation of the ranges.

**2003-2007:** Project Officer at Centre for Applied Research in Electronics, IIT Delhi tasked with:

- R & D in Underwater Signal processing and hardware design.

- Coordinator for M.Tech programme in Underwater Electronics.

**2001-2002:** MTech student, Radar and Communication with specialization in Underwater Electronic at IIT Delhi.

**2014** Visiting Researcher at Institute of Industrial Sciences, Tokyo University. Part of an international project on Freshwater Dolphins being supported by HSBC, WWF(India), IIT Delhi, IIS(Tokyo University) and KDDI Japan. Tasked to coordinate the India trials at multiple site deployments and coordinate with multiple agencies. The project includes design and development of Underwater Signal Processing Hardware.

**2015-2016** Research Fellow at the Acoustic Research Lab, at the Tropical Marine Science Institute (TMSI), of National University of Singapore (NUS). ARL is known globally for its work on underwater robotics, underwater communication and marine mammal research. The one year exposure was extremely fruitful, not just in understanding technology and research, but also in learning the way system development is undertaken. Made very good network with international experts, both in academia and corporate, involved with underwater technology development.

**Have been pushing the concept of Underwater Domain Awareness (UDA) and associated Acoustic Capacity Building, as a critical requirement for India's Maritime Strategy. The strategic perspective has been presented with detailed technology challenges of acoustic capacity building in the Indian Ocean Region.**

## **Educational Qualifications:**

**2009:** Ph.D., IIT Delhi:

Thesis title: Marine Vessel Classification Using Passive Sonar Data. Supervisors: Prof Arun Kumar and Prof Rajendar Bahl.

**2002:** M. Tech, IIT Delhi in Radar & Communication:

1995: Thesis title: Classification of Radiated Noise from Marine Platforms. Supervisors: Prof Arun Kumar and Prof Rajendar Bahl. B. Tech in Electrical Engineering, Naval College of Engineering, Lonavala.

**Additional Qualification:** Customized Naval Operations Analysis Course at Dept of Management Studies, IIT Delhi.

**Experience:**

1. **Project Management Experience:**

- (a) 2003-2007 – As project officer at IIT Delhi, was responsible for multiple R&D projects related to development of cutting edge technologies in Underwater and Acoustic Systems. The clients included Navy, Defence Research and Development Organization, Defence Public Sector Units, etc. Was involved right from conceiving the projects, interacting with the clients (making them feel they need it), going through the tendering process, financial sanctions and then delivering the project with multiple reviews. His biggest achievement was design and implementation of Sonar Classification Algorithms for the First Strategic Submarine Project. He was awarded by the Chief-of-the-Navy commendation for this work.
- (b) 2009-2012 – As Project Manager (R&D) was responsible for multiple R&D and Operations Analysis projects for the Indian Navy and DRDO. These included stealth assessment, upgradation and maintenance of the ranging assets, both offshore and inshore, design and development of analysis protocols, procedures, reporting methods, futuristic developments, etc.
- (c) 2010-2014 – Was assigned the task of Acoustic Stealth Assessment of India's first indigenously built Strategic Submarine. Reviewed the entire design, construction, trials procedures, availability of test infrastructure and requirements, etc from the acoustic stealth perspective. He proposed the entire trial protocols, analysis methodology and even designed the algorithms for analysis and report structure.
- (d) 2012 – Trial team leader for acceptance trials for the Mobile Acoustic Range System being delivered by an Israeli firm for the first time in India. The trials involved two submarines, three ships and multiple shore units with very tight time schedules and operational limitations. The trials had to be done in severe sea conditions to test the limits. For the first time a Technical Naval Officer was chosen as a trial team leader for a trial team comprising of senior scientist from the DRDO and senior operational commanders from the Indian Navy. The trials went beyond the acceptance of the equipment and established complete trial protocols, modifications to the system design to suit local deployment conditions and operational strategies, analysis methodologies and report generation structure.

2. **R&D Experience:**

- (a) 2003-2007 - Centre for Applied Research in Electronics, IIT Delhi as Project Officer responsible for multiple R&D projects for DRDO and Indian Navy. Conceptualized, bid and executed several projects, including sea trials.
- (b) 2004-2007 - Design and development of passive sonar classifier for the strategic submarine project in tropical littoral waters. The project was undertaken as project officer at IIT Delhi and delivered post validation using real data at Underwater Ranges, Goa.
- (c) 2009-2012 - Underwater Ranges, Goa, DRDO as Project Manager (R&D) responsible for Acoustic and Magnetic ranging and analysis of ships

and submarines. Revamped the complete analysis, strategy and also initiated the up-gradation case for the ranges.

(d) 2011-2014 - Defence Research and Development Organization as a team leader for acoustic stealth assessment for Strategic Submarine project. Complete conceptualization, planning and execution of the procedures and standard operating procedures, including design and development of interfacing hardware.

(e) 2007-2014 - Deployment of hydrophone array for long term (over six months annually) passive monitoring of freshwater dolphins at Narora (Ganges river) and Chilika lake. Analysis algorithms and de-noising algorithms for boat noise has been designed and tested. The project done in collaboration with Institute of Industrial Sciences, Tokyo University, IIT Delhi, WWF and Chilika Development Authority.

(f) Deep sea deployment and multiple data recording and analysis of Urashima (Autonomous Underwater Vehicle) at hydrothermal vent locations. Work undertaken as part of a Research cruise onboard JAMSTEC ship R/V Yokosuka (13 Jun -19 Jun 14 and 20 Jun – 24 Jun 14) towards south of Japan.

### 3. **Workshops and Seminars**

- Conducted a number of workshops and seminars on Marine acoustics, underwater signal processing and maritime strategy in DRDO labs in India, National Maritime Research Institute Japan, Acoustic Research Lab NUS Singapore.

- Conducted the first ever National Seminar in India on “Anthropogenic Noise and its Impact on Marine Species”, in Jun 2013. It received wide publicity and significant financial support from the corporate.

### 4. **Academic Experience**

- Taking regular MTech courses at DIAT, Pune in the years 2013-2015. In subjects related to Signal Processing.
- Taking one-credit courses regularly at IIT, Delhi on Signal Processing since 2003, both in Electrical Engineering Dept and CARE.
- Taking Undergraduate Courses in the Military Institute of Training (MILIT), Pune 2013-2015.
- Masters coordinator for MTech programme (2003-2007) in Underwater Electronics (UWE) for the Indian Navy and DRDO students at CARE, IIT Delhi.

## **Research Guidance**

### **PhD Thesis**

1. PhD Thesis titled "Ambient Noise Characterization in Tropical Littoral Waters" Completed by Dr Rajveer Shastri at Marathwada University. Jointly Guided with Prof Y V Joshi.

2. Piyush Asolekar - Ambient Noise Modelling in Tropical Littoral Waters, ongoing at SGGGS Nanded Marathwada University. Jointly being guided with Dr. Suhas Gajre.

3. S Rowl – Underwater Sensor Network protocols for Surveillance Applications in Severe Channel Conditions. Ongoing at DIAT Pune under joint guidance with Dr. C R S Kumar.

4. Jyoti Sadalge – Sediment Classification in Tropical Freshwater Systems, ongoing at SGGS Nanded Marathwada University. Jointly being guided with Prof. Y V Joshi.

**Guided over 40 MTech projects since 2003 at IIT Delhi and DIAT Pune.**

### **Selected Publications**

#### **Journal**

- [1] Arnab Das, Arun Kumar, Rajendar Bahl, "Design of a Comprehensive Underwater Target Classifier for Passive Sonar," Journal of Ship Technology, vol. 3, No. 1, January 2007.
- [2] Arnab Das, Arun Kumar, Rajendar Bahl, "Radiated signal characteristics of marine vessels in the cepstral domain for shallow underwater channel," J. Acoust. Soc. Am. 128 (4), Oct 2010.
- [3] Arnab Das, "Shallow Ambient Noise Variability Due to Distant Shipping Noise and Tide," Journal of Applied Acoustics Vol 72 (2011), pp. 660–664.
- [4] Arnab Das, Arun Kumar, Rajendar Bahl, "Marine Vessel Classification based on Passive Sonar Data: The Cepstrum Based Approach," IET Radar, Sonar & Navigation, Volume 7, Issue 1, January 2013, Pp. 87 – 93.
- [5] Arnab Das, "Naval Operations Analysis in the Indian Ocean Region – A Review," Journal of Defence Studies, Vol 7, No. 1, Jan 2013, pp. 199–206.
- [6] Arnab Das, "Effective Underwater Weapon Systems and the Indian Ocean Region," Journal of Defence Studies, Vol 7, No. 3, Jul 2013, pp. 159–168.
- [7] Arnab Das, "New Perspective for Oceanographic Studies in the Indian Ocean Region," Journal of Defence Studies, Vol 8, No. 1, Jan 2014.
- [9] Arnab Das, "Marine Eco-concern and its Impact on the Indian Maritime Strategy," Journal of Defence Studies, Vol 8, No. 2, Apr 2014.
- [10] MD Nair, Abhilash MT, Vijay Kumar, Arnab Das, "Implementation of Embedded platform for underwater glider prototype" Journal of Marine Engineers, Jul 2014.
- [11] Arnab Das and DSP Varma, "Ocean Governance in the Indian Ocean Region – An Alternate Perspective" Maritime Affairs, 2015, Routledge, Taylor and Francis Group.
- [12] Arnab Das and DSP Varma, "Impact of Biological Noise on Sonar Performance in the IOR" Indian Defence Review, Vol. 30.2 Apr-Jun 2015.
- [13] Piyush Asolkar, Arnab Das, Suhas Gajre, Y Joshi, "Tropical Littoral Ambient Noise Probability Distribution Function Model based on Sea Surface Temperature", JASA-EL, Journal of the American Society of America.
- [14] Arnab Das, "Impact of Maritime Security Policies on the Marine Ecosystem" Maritime Affairs, 2016, Routledge, Taylor and Francis Group.

#### **Conference Papers**

- [1] Arnab. Das, A. Kumar and R. Bahl, "Feature analyses for marine vessel classification using passive sonar," Proc. Intl. Conf. on Undersea Defense Technology, Amsterdam, Netherlands, June 2005.
- [2] Arnab Das, Arun Kumar, Rajendar Bahl, "Study of Feature Discrimination Effects due to Time Varying Channel for Passive Sonar," Proceedings of the IEEE OCEANS-2005 conference at Washington DC from 19-23 Sep 2005.
- [3] Arnab Das, Arun Kumar, Rajendar Bahl, "Classification Feature Analyses in Time Varying Channel for Passive Sonar," Proceedings of the National Symposium on Ocean Electronics, SYMPOL 2005 at Kochi, 15-16 Dec 2005.
- [4] Arnab Das, Arun Kumar, Rajendar Bahl, "Performance Analysis due to Feature Transformation for Automated Marine Vessel Recognition in Cepstral Domain," Proceedings of the IEEE INDICON conference at New Delhi 15-17 Sep 2006.
- [5] Arnab Das, Arun Kumar, Rajendar Bahl, "Comprehensive Ocean Area Surveillance Technology (COAST)," Proc. Seminar on Offshore Infrastructure and Operations, Emerging Security Challenges and Counter Measures 2006, organized by the Offshore Defence Advisory Group (ODAG) at Mumbai.

- [6] Arnab Das, Arun Kumar, Rajendar Bahl, "Improved Estimation of Machinery Tonal Intensity under severe Underwater Channel Distortions," Proceedings of the National Symposium on Ocean Electronics, SYMPOL 2009 at Kochi, 18-20 Nov 2009.
- [6] Arnab Das, "Separation of Propeller Modulation and Machinery Tonals using Homomorphic Filtering," Proceedings of the National Symposium on Ocean Acoustics, NSA 2009 at Hyderabad 26-28 Nov 2009.
- [7] Arnab Das, Arun Kumar, Rajendar Bahl, "Method for Shallow Underwater Channel Inversion using Cepstrum," Indo US workshop on Shallow water Acoustics sponsored by ONR Global at Goa, 3-4 Feb 2010.
- [8] Arnab Das, Kiran Kotha, "Ambient Noise Analysis of Shallow Underwater Channel in Coastal Region," Indo US workshop on Shallow water Acoustics sponsored by ONR Global at Goa, 3-4 Feb 2010.
- [9] Arnab Das, "Novel Signal Separation Technique for Propeller Modulation," Proc. Intl. Conf. on Undersea Defense Technology, Hamburg, Germany, June 2010.
- [10] Arnab Das, C. Jayasharadha, "Surface Weather Data Analysis and its Impact on the Ocean Ambient Noise off the Shallow Indian Coast," Proceedings of the National Symposium on Ocean Acoustics, NSA 2010 at Rishikesh 11-13 Nov 2010.
- [11] Arnab Das, Abhijit Verma, "Radiated Noise of Barges/Crafts in Rivers and their effect on the Aquatic Ecology," Proceedings of the National Symposium on Ocean Acoustics, NSA 2010 at Rishikesh 11-13 Nov 2010.
- [12] Arnab Das, "Regime Definition for Noise Ranging – Speed Vs Shaft RPM," Proc. Intl. Conf. on Undersea Defense Technology, London, UK, 7-9 June 2011.
- [13] Arnab Das, Arun Kumar, Rajendar Bahl, "Realistic Ambient Noise Analysis for Passive Surveillance Algorithm Design," Proceedings of the IEEE OCEANS-2011 conference at Hawai from 18-21 Sep 2011.
- [14] Rahul G. Waghmare, S. L. Nalbalwar, Arnab Das, "Transient signal detection using wavelet packet transform", International Conference on Computer Applications and Network Security, IEEE-ICCANS-2011.
- [15] Rahul G. Waghmare, S. L. Nalbalwar, Arnab Das, "Transient Signal Detection on the Basis of Energy and Zero Crossing Detectors", International Conference on Communication Technology and System Design, ELSEVIER-ICCTSD-2011, 7-9 Dec 2011.
- [16] Rajveer Shastri, Y V Joshi, Arnab Das, 'Gaussianity Analysis of Ambient Noise in Littoral Tropical Water', Presented at RIO Acoustics 2013 IEEE/OES Acoustics in Underwater Geosciences Symposium Centro Empresarial, Rio de Janeiro, 24-26 July 2013.
- [17] Rajveer Shastri, Y V Joshi, Arnab Das, 'Spectral Analysis of Littoral Water Ambient Noise in the Tropical Region', Presented at RIO Acoustics 2013 IEEE/OES Acoustics in Underwater Geosciences Symposium Centro Empresarial, Rio de Janeiro, 24-26 July 2013
- [18] Rajveer Shastri, Y V Joshi, Arnab Das, 'Time Frequency Analysis of Underwater Ambient Noise in Tropical Littoral Waters', Presented at OCEANS'13, MTS/IEEE San Diego conference 23-26 Sept. 2013.
- [19] Rajveer Shastri, Y V Joshi, Arnab Das, 'Comparative analysis of time frequency representations for littoral water ambient noise from the west coast of India,' Selected at Acoustics 2013 organized by Acoustic Society of India and French Acoustical Society at New Delhi.
- [20] Chakshu Malvia and Arnab Das, "C.O.A.S.T- Comprehensive Ocean Area Surveillance Technology for Indian Ocean Region" Poster presentation at Underwater Technology Workshop at NIOT Chennai, 21 Oct 13.
- [21] Arnab Das and Tomonari Akamatsu, "Issues and an Optimal Application of Acoustic Survey for Freshwater Cetaceans", IEEE OES, Underwater Technology Conference, UT-15, NIOT Chennai, Feb 2015.
- [22] Jyoti A. Sadalage and Arnab Das, "Precise Estimation of Sound Velocity Profile and its Impact on Sediment Classification in the Tropical Shallow Freshwater

- Reservoirs*", IEEE OES, Underwater Technology Conference, UT-15, NIOT Chennai, Feb 2015.
- [23] Soubhagya Roul and Arnab Das, "*Coastal Surveillance Networks using AVS and Blue Green Lasers*", IEEE OES, Underwater Technology Conference, UT-15, NIOT Chennai, Feb 2015.
- [24] Jyoti Sadalage, Arnab Das and P. Mukherjee, "*Sediment Classification Using Side Scan Sonar Imagery*", 12<sup>th</sup> Western Pacific Acoustic Conference 2015, Singapore, 6-9 Dec 2015.
- [25] Arnab Das, Venugopalan Pallayil, "*Analysis of Effective Signal Design for Active Sensing of Undersea Objects/Bottoms in Tropical Littoral Waters*" Presented at the MTS/IEEE, OES OCEANS 2016, Shanghai, 10-13 Apr 2016.
- [26] Piyush Asolkar, Arnab Das, Suhas Gajre, Y Joshi, "*Validation of Webster Ambient Noise Model for Real Data in Tropical Littoral Water*" Presented at the MTS/IEEE, OES OCEANS 2016, Shanghai, 10-13 Apr 2016.
- [27] Rajveer Shastri, Arnab Das, Y V Joshi, "On the Selection of Time Frequency Feature Set to Represent Passive Sonar Data of Tropical Waters" Presented at the MTS/IEEE, OES OCEANS 2016, Shanghai, 10-13 Apr 2016.
- [28] Arnab Das, Venugopalan Pallayil, "*Validation of Channel Model for Evaluating the Performance of Probing Signal Design in Shallow Tropical Waters*" Presented at the MTS/IEEE, OES OCEANS 2016, Monterey, USA, 19-22 Sep 2016.
- [29] Piyush M. Asolkar , Arnab Das, Suhas S. Gajre and Yashwant V. Joshi, "*Simulation of Colored and Non-Gaussian Wind Noise for Tropical Shallow Waters*" Presented at the MTS/IEEE, OES OCEANS 2016, Monterey, USA, 19-22 Sep 2016.
- [30] Jyoti Sadalage, Arnab Das and Yashwant V. Joshi, "*Echo Signal Analysis for Underwater Sediment Classification in Tropical Regions*" Presented at the MTS/IEEE, OES OCEANS 2016, Monterey, USA, 19-22 Sep 2016.
- [31] Vidhya Shinde, Rajveer Shastri,, Arnab Das et. al., "*Analysis of Adaptive Filtering Techniques for Fresh Water Dolphin Signals in their Natural Habitat*" Presented at the MTS/IEEE, OES OCEANS 2016, Monterey, USA, 19-22 Sep 2016.

### **Technical Reports**

- [1] Technical Report, CARE/SP/TD/2010/1, titled "Synthetic Data Generation for Radiated Noise of Marine Vessels," Apr 2010, available at [http://care.iitd.ac.in/spg/spg\\_research.htm](http://care.iitd.ac.in/spg/spg_research.htm).

### **Book**

- "Marine Eco-concern and its Impact on the Indian Maritime Strategy". Published on 02 Feb 2017. Supported by the Indian Maritime Foundation.