

# EMeDS 2018

Indo-US Workshop on  
**Emergency Medical Delivery  
Systems (EMeDS) Integrating  
Unmanned Aerial Vehicles**



**5-7 March 2018**  
**CPDM, Indian Institute of Science,**  
**Bengaluru, India**

## Workshop Venue: Center for Product Design and Manufacturing, Indian Institute of Science, Bangalore



The workshop will be held at the Center for Product Design and Manufacturing (CPDM), IISc. The department is located in the green campus of IISc in the heart of Bengaluru and well connected to airport, train and bus stations.

### Related information:

Host Institution: Design Division, Aeronautical Society of India.

([www.aerosocietyindia.in](http://www.aerosocietyindia.in))

US Partner Institution: Villanova Center for Analytics of Dynamic Systems, Villanova University ([www.villanova.edu](http://www.villanova.edu); [vcads.org](http://vcads.org))

Workshop Sponsor: Indo-US Science and Technology Forum ([www.iusstf.org](http://www.iusstf.org))

Workshop website: <http://vcads.org/emeds>

## Background and Objectives of the Workshop

Medical Emergencies often occur on the road in congested urban areas or remote rural areas with rapid access to expert telephone emergency medical dispatch (108), but with delayed arrival of medical professionals and basic lifesaving equipment. In urban, rapidly developing India, congested traffic and road conditions are particularly challenging. Recent advancements in geospatial localization, optimization science, and drone technology have prompted technology companies to explore these methodologies for delivery of commercial goods. Adaptation of this concept to respond to deliver equipment and professional visual-guided coaching to lay first responders at road traffic accidents in congested urban or rural environments could be very impactful resulting in saving human lives and limbs. Additional important potential applications of drone technology in high traffic cities (e.g. rapid delivery of blood or vital organs for transplant) should be considered. When implemented, such systems and paradigm shift could be transformative, changing the emergency medical landscape and saving thousands of lives in India.

To address this challenge, we assembled a workshop to bring together highly interdisciplinary teams of experts from India, Europe, New Zealand, the UK and

USA. Diverse expertise includes systems engineers, and experts in optimization science, unmanned aerial technology (e.g. navigation, control, aerodynamics), emergency and critical care medicine, Indian Emergency Response System and Telephone dispatch, the rural health mission and ministry of health in India, and the WHO.

The Design Division, Aeronautical Society of India (AeSI) and Villanova University Center for Analytics of Dynamic Systems( VCADS), USA are the coordinating partners of this joint workshop and bring together specific interest groups from academic, private and government institutions, both in India and the USA.

The top priority will be to describe and attain consensus on top priorities for design specifications and specific R&D needed to improve Emergency Medical Delivery systems integrating UAVs (EMeDS). Immediate, short and long term goals and metrics for success will be identified. Following the workshop, interdisciplinary working groups will be formed to accelerate EMeDS platform/process design and development activities in India, collaboratively connect these efforts with similar groups and entities in USA, and develop strategically focused proposals to submit to appropriate funding organizations.

## Organizing Committee

**Kota Harinarayana, PhD (Indian Coordinator)**

Aeronautical Society of India, Bengaluru, India

**C. 'Nat' Nataraj, PhD (US Coordinator)**

Villanova University, Villanova, USA

**Vinay Nadkarni, MD**

Children's Hospital of Philadelphia, USA

**Upendranath Vanam, PhD**

National Aerospace Laboratories, Bengaluru, India

**B. Gurumoorthy, PhD**

Indian Institute of Science, Bengaluru, India

**G. V. Ramana Rao, MD**

GVK Emergency Management and Research Institute, Hyderabad, India

**K. Ramachandra, PhD (Convener)**

Director, National Design & Research Forum, India

**Rakesh Kumar** Treasurer, Design Division, Aeronautical Society of India

## Workshop at a Glance

Invited Speakers	16
Thematic Groups	4
Students participating in group meetings	~10
Academic Faculty/Researchers participating in group meetings	~ 20
Industry participants	~10
Total number of participants	~60

## Program Schedule- EMeDS 2018

(Each invited presentation lasts **25 minutes followed by 5 minutes Q&A**)

### Monday 5 March 2018: Day 1

- 07:30-08:45 Breakfast
- 08:00-08:45 Registration
- 08:45-09:30 Inauguration with opening remarks from Workshop Coordinators ( Prof C. Nataraj / Dr Kota Harinarayana); Prof. Gurumoorthy, IISc; Rep IUSSTF; Dr RK Tyagi, President AeSI; Dr VK Aatre, Former Head, DRDO ) and participant introductions

### Topic: (i) Emergency Medical Response

- 09:30-10:00 **Current status of Emergency Response Services in India**  
Dr G V Ramana Rao, Director, Emergency Medicine Learning Centre and Research, GVKEMRI, Hyderabad
- 10:00-10:30 **Potential use of drones for emergency response**  
Dr Vinay Nadkarni, Endowed Chair, Professor, Department of Anesthesia and Critical Care Medicine, Medical Director, CHOP Center for Simulation, Advanced Education, and Innovation
- 10:30-11:00 Tea Break
- 11:00-11:30 **Current state of emergency response for myocardial infarction and stroke (Heart Safe Community)**  
Dr Aruna Ramesh, Professor & HoD, Emergency Medicine, MSR Hospital, Bengaluru
- 11:30-12:00 **Use of smart vehicle technology for optimizing emergency response**  
Dr. Matthew R. Maltese, Research Assistant Professor, Children's Hospital of Philadelphia and the University of Pennsylvania, USA.
- 12:00-12:30 **Building emergency care systems by matching supply and demand**  
Dr Brendan Carr, Professor & Associate Dean, Sidney Kimmel Medical College, Thomas Jefferson University, PA, USA
- 12:30-13:30 **Panel Discussion on Topic:**  
Moderators: Dr Vinay Nadkarni, Prof Nataraj  
Panelists: Shri R. Raghu, ISRO; Shri Jitendra J Jadhav, Director NAL, Bengaluru; Dr Mukund Rao, NIAS, Bengaluru; Dr Jose Ferrer, American Heart Association International, USA; Dr Shyam Vasudeva Rao, Forus Health, Bengaluru; Dr. Alex Thomas, AHPI, Bengaluru  
(5 minutes for each panelist to contribute more on topic, followed by 30 min of Q and A for Moderators, Panelists, Participants)
- 13:30-14:15 Lunch

**Topic: (ii) Organ transport: Anticipated challenges for UAV delivery of Medical Equipment**

- 14:15-14:45 **Needs, Operations and requirements of UAVs for delivery of organs and medical supplies**  
Dr. Kota Harinarayana, Chairman, Design Division, AeSI, Bengaluru
- 14:45-15:15 **Transporting heart for heart transplant: One hospital's experience and its implications for UAV transport in the Indian context**  
Prof Easwaran Subrahmanyam, Research Professor, Institute for Complex Engineered Systems  
Carnegie Mellon University, USA
- 15:15-15:45 Tea Break
- 15:45-16:15 **Current challenges with Organ Ischemia and Organ Transport in India**  
Dr Sunil Shroff, Managing trustee, MOHAN Foundation, Chennai
- 16:15-16:45 **LifeBox: An active heart perfusion container for extending preservation times during transport by drones.**  
Prof Gurumoorthy, IISc, Bengaluru
- 16:45-17:15 **Technologies of Unmanned vehicles being developed at CSIR-NAL**  
Mr PV Satya Narayana murthy, CSIR-NAL
- 17:15-18.15: **Panel Discussion on Topic**  
Moderators: Prof Gurumoorthy, Prof Eswaran Subramanyam  
Panelists: Prof. Raghunath IIMB; Dr K.R. Balakrishanan, Malar Hospital, Chennai; Dr Ramesh, MSR Hospital, Bengaluru; Rep- DIPAS, New Delhi (5 minutes for each panelist to contribute more on topic, followed by 30 min of Q and A for Moderators, Panelists, Participants)
- 1815-1830: **Summary of day's proceedings by Dr Kota Harinarayana & Prof C. Nataraj**
- 1830-1930: Break
- 1930-21:30 Dinner

**Tuesday 06 March 2018: Day 2**

- 07:30-08:45 Breakfast
- 08:45-09:15 Opening Remarks (Workshop Coordinators: Prof C. Nataraj / Dr Kota Harinarayana) and Goals for the Day

**Topic: (iii) Emergency medicines/tools transport to remote areas**

**Related work in the lab and field: Progress and Pitfalls**

- 09:15-9:45 **Research and development of UAV control: challenges with practical constraints**  
Dr C. Nataraj, Professor & Director, Villanova Center for Analytics of Dynamic Systems,  
Villanova University, USA
- 09:45-10:15 **Optimizing access to defibrillators for cardiac arrest in the community: Planning for a drone network in Canada**  
Dr Steve Brooks, Department of Emergency Medicine Queen's University at Kingston Canada

- 10:15-10:45 Tea Break
- 10:45-11:15 **Perspective from New Zealand – challenges and opportunities in a country with diverse topography and different regulatory framework**  
Dr Michael Shepherd, Auckland District Health Board, Auckland, New Zealand
- 11:15-11:45 **Development of drones at General Aeronautics**  
Mr Abhishek Burman, CEO, General Aeronautics
- 11:45-12:15 **Drone Doctor Development- Work at IISc**  
Prof S N Omkar, Head, UAV Lab, Department of Aerospace Engineering, Indian Institute of Science, Bengaluru
- 12:15-13:15 **Panel Discussion on Topic:**  
Moderators: Dr Steven Brooks, Dr Kota Harinayana  
Panelists: Dr Jose Ferrer, AHI, USA; Dr UK Singh, Director, DEBEL, Prof. Manish Arora, CPDM, IISc; Shri Hanumantha Rayappa, ISRO
- (Given 5 minutes each to contribute more on topic, followed by 30 min of Q and A for Moderators, Panelists, Participants)
- 13:15-14:15 Lunch

**Topic: (iv) Technical, Medico-legal, Regulatory and Practical challenges and solutions**

- 14:15-14:45 **Telemedicine and its application to remote areas**  
Dr Ganapathy, Apollo Hospitals, Chennai
- 14:45-15:15 **Regulatory, compliance, standards unique to India**  
Dr Ramachandra, Director, NDRF, Bengaluru
- 15:15-15:45 Tea Break
- 15:45-16:15 **Security issues, public safety**  
Speaker: Dr MA Saleem, IPS, Govt of Karnataka
- 16:15-16:45 **Legal aspects of application of Drones for medical emergencies**  
Prof. Balakista Reddy, NALSAR, Univ. of Law, Hyderabad
- 16:45-17:15 **Type of organization needed to take this forward**  
Prof. G Raghuram, Director, IIM Bengaluru
- 17:15-18.15: **Panel Discussion on Topic:**  
Moderators: Dr Ramachandra, Dr Vinay Nadkarni  
Panelists: Prof Sudhakar, IIT Bombay (retired); Dr Murali Krishna, Rep DGCA ; Prof. Chiranjib Bhattacharjee, IISc ,Bangalore given 5 minutes each to contribute more on topic, followed by 30 min of Q and A for Moderators, Panelists, Participants)
- 1815-1830: **Dr Kota Harinarayana and Prof C Nataraj: summary & feedback/comments from participants and Instructions for program for Day 3**

## Wednesday 07 March 2018: Day 3

07:30-08:45 Breakfast

08:45-09:15 Opening Remarks (Workshop Coordinators: Prof C. Nataraj / Dr Kota Harinarayana) and Goals for the Day

### **Stated goals for conference:**

- 1) Primary Objective: Clearly define the concept of operation and obtain clarity on the specific R&D on Emergency Medical Delivery system integrating UAVs (EMeDS) that needs to be done with short and long term goals and metrics for success.
- 2) Secondary objectives:
  - a. Form interdisciplinary working groups to follow upon EMeDS platform/process design and development activities in India and connect these efforts with similar groups and entities in USA through future joint collaborations.
  - b. Develop a white paper and fully informed proposal that will be submitted to a funding organization.

**Topic: Interdisciplinary Working groups finalise the concept of operations and clarify Specific R,D&D for EMeDS with short and long term goals and metrics for success**

09:15-10:00 4 Breakout groups (45 minutes in a group)

10:00 -10:45 4 Breakout groups (45 minutes in a group)

10:45-11:15 Tea Break

**Topic: Secondary Objectives: Interdisciplinary Working Groups follow up and white paper/proposal for funding development**

11:15-12:00 4 Breakout groups (45 minutes in a group)  
WG (Work Group) 1, WG 2, WG 3, WG 4

12:00-12:45 4 Breakout groups (45 minutes in a group)  
White Paper 1, White Paper 2, Funding proposal 1, Funding proposal 2

12:45-13:30 Breakout group summary, Thank you's from Workshop Coordinators  
Feedback and evaluation of workshop

13:30-14:30 Lunch and disperse

## List of Speakers/Panelists/Participants

### International

1. Dr. Brendan Carr, Professor & Associate Dean, Sidney Kimmel Medical College, Thomas Jefferson University, USA	brendan.carr@jefferson.edu	Speaker
1. Dr. Chandrasekhar Nataraj, Villanova University, USA	c.nataraj@villanova.edu	Speaker & US Coordinator
2. Dr. Easwaran Subrahmanian, Institute for Complex Engineered Systems, Carnegie Mellon University, USA	sub@cs.cmu.edu	Speaker
3. Dr. Jose Maria Enriquez Ferrer, American Heart Association International, Dallas TX , USA	jose.ferrer@heart.org	Speaker
4. Dr. Matthew Maltese, Children's Hospital of Philadelphia, USA	maltese@email.chop.edu	Speaker
5. Dr. Michael Shepherd, Auckland District Health Board, New Zealand	michaels@adhb.govt.nz	Speaker
6. Dr. Steven Brooks Department of Emergency Medicine, Royal Infirmary of Edinburgh, UK	brookss1@kgh.kari.net	Speaker
7. Dr. Vinay Moreshwar Nadkarni, Children's Hospital of Philadelphia, USA	nadkarni@email.chop.edu	Speaker

### Indian

8. Dr Aatre Vasudev K, Former Sec'y/Head, DRDO	vasudevaatre@yahoo.com	Speaker
9. Dr. Abhishek Burman General Aeronautics , IISc, Bangalore	abhishek.burman@generalaero- nautics.com	Speaker
10. Mr. Akhilesh , NDRF, Bangalore	akhilesh0792@gmail.com	Participant
11. Dr Alex Thomas ,AHPI ,Bangalore	alexthomas.ahpi@gmail.com	Panelist
12. Dr Aruna Ramesh, MSR Hospital, Bangalore	arunacr2@gmail.com	Speaker
13. Prof. Ashitava Ghosal , ME & CPDM IISc ,Bangalore	asitava@iisc.ac.in	Participant
14. Prof. Balan Gurumoorthy, IISc, Bangalore	bgm@iisc.ac.in	Speaker & Organizer
15. Shri Balakista Reddy, NALSAR University of Law, Hyderabad	registrar@nalsar.ac.in/ balakista@gmail.com	Speaker
16. Dr K R Balakrishnan, Malar Hospital, Chennai	cvskrb@gmail.com	Panelist
17. Dr R Balasubramaniam, AeSI	editoraesi@yahoo.com / rbse_99@yahoo.com	Participant

18. Mr. Bhaskar Rao , IPS	deepolice@gmail.com / gunascrb@gmail.com	Participant
19. Prof. Bhardwaj Amruthur, ECE, IISc, Bangalore	amrutur@iisc.ac.in	Participant
20. Dr. Bhuvnesh Kumar, Director, DIPAS,DRDO , New Delhi	director@ dipas.drdo.in	Participant
21. Dr Bontha V Babu ,Scientist - G & Head ,Division of Socio- Behavioural & Health Systems Research, Indian Council of Medical Research, New Delhi - 110 029, India	babubontha@gmail.com/ babubv@icmr.org.in	Participant
22. Ms.Chaitra G S, CPDM, IISc, Bangalore	chaitrak@iisc.ac.in	Participant
23. Prof. Chiranjib Bhattacharjee, Computer Science. IISc Bangalore	chiru@iisc.ac.in	Panelist
24. Dr K Ganapathy , Apollo Hospitals, Chennai	drganapathy@apollohospitals.com	Speaker
25. Mr Hanumantha Rayappa , telemedicine initiative ISRO.	rayappa@isro.gov.in	Panelist
26. Dr. Jitendra Jadav ,Director, National Aerospace Laboratories, Bangalore	director@nal.res.in	Panelist
27. Ms. Keerthi Unnikrishnan , Aero Space Engg, IISc	keerthiunni93@gmail.com	Participant
28. Dr.Kota Harinarayana, Chairman, Design Division, AeSI, Bangalore	hnkota@yahoo.com	Speaker & India coordinator
29. Dr Manan Oza Scientist C DIPAS DRDO Delhi	mananoza@gmail.com	Panelist
30. Prof. Manish Arora, CPDM, IISc, Bangalore	marora@iisc.ac.in	Panelist
31. Dr. Murali Krishna, Malar hospital in Chennai	dr_muralikrishna96@yahoo.com	Participant
32. Dr. Mukund Rao, NIAS Bangalore	mukund.k.rao@gmail.com	Panelist
33. Prof S.N. Omkar Subbaram Jois Narasipura, IISc Bangalore	omkar@aero.iisc.ernet.in	Speaker
34. Dr K Ramachandra, NDRF, Bangalore	drkrc2006@gmail.com	Speaker & Organizer
35. Dr Ramaseshan , General Aeronautics	ramaseshan.satagopan@generalaer onautics.com	Participant
36. Prof G Raghuram, Director, IIM Bengaluru	graghu@iimb.ac.in	Speaker
37. Prof S. Raghunath, Corporate Strategy and Policy, IIM Bengaluru	srnath@iimb.ac.in	Panelist
38. Mr Raghu S, Deputy Director, CBPO, ( capacity building programme office ), ISRO	raghuravindran@hotmail.com	Panelist
39. IUSSTF – Rep. New Delhi	ed@indousstf.org	Participant
40. Mr. Rakesh Kumar, Design division, AeSI, Bangalore	aerorakesh@gmail.com	Participant & Organizer
41. Dr G V Ramana Rao, Director, GVK EMRI, Hyderabad	ramanarao_gv@emri.in	Speaker & Organizer



42. Dr D Ramesh, MSR Hospital, Bangalore	arunacr1@gmail.com	Panelist
43. Dr Ramnarayan, DGAero, DRDO, Bangalore	dgaero@hqr.drdo.in	Participant
44. Dr M A Saleem, IPS, Govt of Karnataka	masaleem93@gmail.com	Speaker
45. Mr Satyanarayana Murthy, CSIR-NAL	satya@nal.res.in	Speaker
46. Prof Senthil Kumar, MIT Chennai	ksk_mit@rediffmail.com ksk.mit@gmail.com	Participant
47. Dr Shyam Vasudeva Rao, Forus Health, Bangalore	shyam@forushealth.com	Panelist
48. Mr Sri Kumar Pullat, NIAS, Bangalore	skpullat@gmail.com	Participant
49. Prof K.Sudhakar, IIT,Bombay (retd ), Wayanad, Kerala	sudhakar.iitb@gmail.com	Panelist
50. Dr Sunil Shroff , Mohan Foundation, Chennai	mohanfound@gmail.com	Speaker
51. Dr RK Tyagi, President, AeSI, New Delhi	rkyagi.hal@gmail.com	speaker
52. Dr U.K.Singh, DEBEL,DRDO Bangalore	director@debel.drdo.in	Participant
53. Dr V Upendranath, NAL Bangalore	vanam.upendranath@gmail.com	Organizer
54. Mr Yash Jahgirdar	yogendra@japaero.org	Participant

## Students/Volunteers

55. Dr Abhishek KB, MSR Hospital	abhishek.kb206@gmail.com	participant
56. Aejaz Ahmad, NDRF	aejazaritumkur@gmail.com	participant
57. Deval Karia, CPDM, IISc	deval.karia.07@gmail.com	participant
58. Keerthi Unnikrishan, Aerospace Eng., IISc	keerthiunni93@gmail.com	participant
59. Rohit S. Nambiar, CPDM, IISc	rohitsnambiar@gmail.com	participant
60. Dr. Sai Saranya, MSR Hospital	drsharilal@gmail.com	participant
61. Vaibhav Goswami, CPDM, IISc	vaibhavg@iisc.ac.in	participant
62. Vivek Sharma, CPDM, IISc	viveksharma@iisc.ac.in	participant
63. Bharathi.N , CPDM, IISc	nbharathi@iisc.ac.in	Participant
64. Prema G , CPDM, IISc	premag@iisc.ac.in	Participant
65. Naveen, CPDM, IISc	naveenmaddu@iisc.ac.in	Participant