

## **Historic Conference on Micro Aerial Vehicle and Unmanned Ground Vehicle Technologies at Agra jointly by CSIR, DRDO and US DoD**

The National Aerospace Laboratories, Bangalore, a constituent of the Council of Scientific and Industrial Research (CSIR) and the Aerial Delivery Research and Development Establishment, Agra, a constituent of the Defense Research and Development Organization (DRDO) partnered with the U. S. Army Research, Development and Engineering Command(RDECOM)'s International Technology Center – Pacific in a collaborative effort to host the first U.S. - Asian Demonstration and Assessment of Micro Aerial and Unmanned Ground Vehicle Technologies during March 10 – 15, 2008 at the Jaypee Palace Hotel, Agra.

The event was mainly sponsored by the U. S. Department of Defense, in particular the R&D wings of US Army(RDECOM), US Navy(ONR-G), US Air Force(AOARD) and the Defence Advanced Research Projects Agency(DARPA).

The event had been extended full support by DRDO, CSIR and the Indo-US Science and Technology Forum (IUSSTF).

The purpose of the Conference was (i) to showcase next-generation, COTS enabled prototype systems of Micro Air Vehicles(MAV) and Unmanned Ground Vehicles(UGV) that are almost ready for end-use, thus hasten their induction into the Forces (ii) identify areas for further development of critical technologies and (iii) evolve ideas and strategies for countermeasures. It was expected to give a major fillip to the current developmental efforts in India in the area of MAVs and UGVs by presenting the state-of-the-art in technologies and indicating the future trends in research and development in the area.

The subject is highly relevant as the Defence Services need systems appropriate to Military Operations in Urban Terrain (MOUT), Light-Combat Survivability and Force Protection (FP). Presently such support is being given by a larger class of UAVs, but MAVs definitely enjoy greater advantage. The systems are also important for civilian applications such as disaster management, urban traffic monitoring, search and rescue operations etc.

It may be noted here that two previous editions of the event were held in Germany in the years 2003 and 2005. They mainly concentrated on proving platform technology, but mission capability and adaptability was now the major goal.

The event consisted of demonstration cum assessment(both static and flying) of MAV/UGV entries from participating teams as per mission requirements specified for the event. The mission scenario was a mixture of operational and developmental flight test maneuvers, and mission tasks were combined to create a unique and challenging demonstration environment for the prototype MAV systems. The objective of the competition was to demonstrate how combinations of MAV and UGV systems controlled by a team of human operators can effectively conduct a simulated hostage rescue mission.

The rules governing the demonstrations was tuned to elicit the following capabilities: Cooperatively and autonomously flying group of MAV; Cooperation between group of MAV and UGV; Collision and obstacle avoidance and de-confliction; Extrication from confined spaces using vision-based navigation; On board storage and processing of information; Mapping and photographing interiors of buildings; Acoustic sensing; Ability to perch and stare, Chemical sensing etc.

Prototype systems were required to perform a prescribed mission wherein the systems (MAVs and UGVs) were designed to assist a group of commandos to rescue hostages being held by an insurgent group in a bank building. There were booby traps (mines and explosives) laid out

around the building and armed insurgents were circling the building in a vehicle. The MAVs and UGVs , working together, assisted in decommissioning the mines, identifying the location of explosives and the hostages and also identifying a path for ingress by commandos.

While the main venue of the Conference was the Jaypee Palace Hotel, Agra, the mission compliance demonstrations by the teams took place at the Drop Zone in Agra, which is an Indian Air Force facility.

Twelve teams from international academia, government and industry (two from USA, one each from Germany, France, Spain, Netherlands, Japan, Australia and four from India) conducted briefings, displayed their entries and associated technologies, and demonstrated capability for mission compliance through aerial demonstrations during the five day technology event. An International Judging Panel evaluated the entries on their performance. A three day specialist's conference was also held concurrently by 15 subject matter experts of distinction from abroad and India to address research and development critical to the next generation of micro air vehicle systems.

An International Organising Committee (IOC) planned and coordinated the overall organizational efforts in association with NAL, Bangalore, ADRDE, Agra and RDECOM's International Technology Centre-Pacific. A National Advisory Committee chaired by SA to RM and consisting of eminent personalities from the concerned scientific departments and user communities in India provided advice and guidance to the Organisers. The local organizational effort at Agra was led and coordinated by ADRDE, Agra with full assistance from and active participation of Air Force Station and Para Brigade at Agra.

The Inaugural program on 11<sup>th</sup> March 2008 was chaired by Dr.A.R.Upadhya, Director, NAL. The program began with military band in attendance. Dr Upadhya made opening remarks about the event and welcomed all the invitees and participants. Dr D Banerjee CC R&D(AMS), DRDO and Col. J Bass, Commander, US Army, ITC PAC delivered the welcome address on behalf of the Indian and U.S sides. The key note addresses were delivered by Lt.Gen. M.L.Naidu, PVSM,AVSM,YSM , VCoAS, Indian Army and BG (S) Peter Fuller,Deputy Commander, U.S Army, Research, Development & Engineering Command . Lt.Gen(Retd). Dr. V J Sundaram, Advisor, National Design and Research Form(IE) in his invited talk 'R&D Programmes pertaining to MAVs and UGVs in India' gave an overview of the on-going activities related to MAV technology in various institutions in India. From the US side, Col John Wright, Deputy Director, Aviation and Missile Research, Development and Engineering Center, USA spoke on 'US Army Science & Technology (S&T) Challenges for Unmanned Aircraft Systems. LTC Eric Stierna, ITC-PAC gave an overview of the MAV08 missin definitions. Mr Balraj Gupta, Director, ADRDE,Agra delivered the vote of thanks on behalf of the organizers.

The total no. of participants in the event was about 300. There were about 120 participants from abroad, nearly 50 of them from US Army, Air force and the US Office of Naval Research Global(ONRG). The number of Indian participants was about 180, mostly invitees from Council of Scientific and Industrial Research, Defence Research and Development Organisation, Defence Services, INDO-US Science & Technology Forum and other concerned Govt. Departments, Research Organisations, Academic Institutions, and industries.

A Welcome Dinner was hosted by the Organizers on 10<sup>th</sup> June 08. A Banquet Dinner was hosted on 14<sup>th</sup> June 08 jointly by Executive Director, Indo-US S&T Forum and Director, NAL.

A Spouse Tour Programme was organized parallelly involving visits to the world-famous Taj Mahal, Agra Fort, Fatehpur Sikri and Agra's Shopping markets. A visit to the Taj Mahal was also organized for all the participants.

On 15<sup>th</sup> March 2008 – the final day of the event - each of the demonstrators explained their approach to their respective design and were asked to provide a retrospective view. This was

followed by a panel discussion by representatives of the potential user community (both from India and abroad) who provided their impressions and feedback to the organizers and contestants. Recognition of the meritorious teams (Best Mission Performance, Best Hover Performance/Rotorcraft, Best Autonomous MAV, Best Exotic Design MAV, Best UGV Performance) by Dr.Barbara Machak, Director, ARDEC, NJ, USA brought down the curtain on the event.

The event demonstrated that significant progress had been made in technologies of constituent systems of MAVs. Achieving a physical size of less than 300mm was now possible. However issues of system integration and reliability, sensing, and efficient communication between MAVs, and MAVs and ground systems(including UGVs) were brought to focus and these need to be addresses before the systems could gain user acceptance.

The event has benefited the MAV community in India by giving an exposure to the state-of-the-art in MAV technology and will spur speedy developments in the country in this strategically important area.

Following the event some technology areas have been identified for possible cooperation between concerned agencies in India and the US. These include power sources for endurance and covert operations, collision avoidance, communications, onboard processing and autonomous decision making capabilities and increasing the sensitivity of bio-sensors to detect explosive substances with low-vapor pressures.





