MICRO UAVs in DET

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Abstract: Since 2002, the DET (the technical expertise part of the DGA, the French defense procurement agency) has been organizing a set of competencies and facilities to meet the testing and owner assistance requirements for activities ordered by the DGA's program services in the field of micro and mini UAVs (Unmanned Air Vehicles). These UAVs should be used to assist the dismounted soldier in his advance through a hostile urban environment, or even through buildings or tunnels. The specific competencies made available support the existing expertise in weapon systems and forces concerned with these UAVs: mastery of the air/land environment and observation/intelligence.

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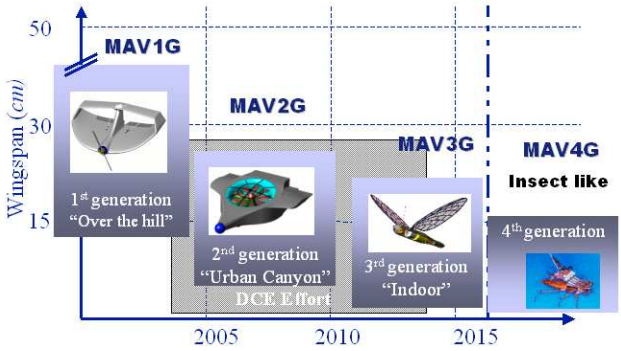
1. Current DGA actions

DGA has defined four generations of mini and micro UAVs. The first generation is composed of fixed wing mini UAVs that correspond to currently in service light weight UAVs, which are flying in open space. The second generation is composed of UAVs able to perform stationary and low altitude urban flight. The third generation refers to future micro UAVs capable of stationary and indoor flight. Finally, the fourth generation groups potential futuristic concepts of UAVs.



Concerning the first generation UAV, DGA is currently in the process of acquiring fixed wings UAV for the french army in the DRAC (Drone de Renseignement au Contact) operation.

The second generation is the subject of most of the current studies. A prototype of a ducted fan UAV, with obstacle avoidance capacities is currently under development. First flights were performed in late 2004. Further developments and extended flight testing are scheduled for 2005. Concerning this generation, DGA is also sponsoring a mini UAV contest (or challenge), organized by ONERA (http://concours-drones.onera.fr). In this international competition, 18 teams of french schools and universities have been sponsored to develop a prototype UAV able to perform stationnary flight in a urban context. The final evaluation of this 3 years competition is scheduled to take place in September 2005.

Concerning the third generation UAVs, various actions have been taken in the fields of mems and biologically inspired robotics, to evaluate the potential of these technologies for future UAVs. As the field is very prospective, with a wide area of rapidly evolving technologies involved, DGA has launched a study to build a virtual prototyping tool for micro robots and micro UAVs. Called Proved Dominic, this prototyping tool aims at capitalizing knowledge about subsystems potentially involved in a UAV so as to be able to conduct studies on the impact of individual technologies on the global mission performance.

Finally, the fourth generation is the subject of preliminary feasibility studies on particular aspect of future systems, such as flapping wings technologies. Actually, a first prototype of dragonfly wings has been manufactured by a fully integrated MEMs design technology. The objective is now to manufacture the overall structure by combining micro power cells with the central body of the insect

2. Expertise and test facilities

Since 2002, several DGA expertise and test facilities have been involved in the development of micro UAVs.

Leading this action, the Technical Center of Arcueil (CEP/Arcueil) initiated in 2002 a federative project among its departments on this subject. The objectives of this project is to develop an expertise capacity in the DGA, mostly for the third and fourth generation of micro UAVs. The various capacities of CEP/Arcueil have been involved in order to face the high degree of integration of

emerging technologies and the severe constraints surrounding these systems. The robotic and perception team is involved in the definition and evaluation of potential sensors, such as optical, IR, radar and laser sensors, and algorithms for theses systems, including obstacle detection and avoidance, simultaneous environment mapping and UAV localization, image mosaicking and target tracking. It is also working on the simulation of these systems and their subsystems for the global assessment of performances using virtual prototyping tools. The material science department is involved in the evaluation of the potentialities of mems technologies for micro UAVs structure and propulsion.

The Laboratory for Ballistic and Aerodynamic Researches (LRBA) brings in its competencies in the field of performance assessment from an operational mission point of view. This includes the integration of every functional chains, from mission planning to the precision of target designation. The goal is to point out which subsystem limits the performance of the overall system. This is achieved mostly by simulations which embed the robots in a realistic operational environment. The LRBA is also leading advanced studies on the navigation, guidance and control chain. The field of these studies ranges from micro inertial sensors to complete miniature navigation systems. In order to assess and develop innovative navigation, guidance and control technologies, the LRBA has created the Autonomous Navigation Laboratory. This laboratory is involved in the development of new sensor fusion algorithms for localization and navigation, of vision-based techniques for localization and navigation, of collaborative navigation for a fleet of heterogeneous robots and of bio-inspired navigation, guidance and control techniques.

Finally, the Technical Establishment of Angers (ETAS) employs its evaluation facility for small mobile robots in urban area to evaluate micro UAVs. It takes advantage of its tight relations with armed forces to propose representative testing scenarios. The robotics team is more particularly concerned, making the most of its knowledge about automated systems to help evaluating UAVs and modeling them, as ETAS is also involved in the use of hybrid simulation for concept validation. Finally ETAS is working on coherently integrating these systems into wider future ones, while always taking care of interactions between them and human operators to ease their command and deployment.