RPAS

REMOTELY PILOTED AIRCRAFT SYSTEMS

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European Group of Institutes of Navigation

Views on RPAS-related Technologies

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European Group of Institutes of Navigation is a non-profit-making international association. Its objectives are to:

- Initiate and support actions assisting in the development of pan European policies and strategies in the general fields of navigation and traffic management;
- Participate in study work initiated by the European authorities;
- to foster co-operation and information exchange between its Members and competent authorities or organisations active in the general fields of navigation and traffic management;
- Provide information in its field of expertise by organising conferences and symposia, publishing papers; and participating in data dissemination;
- Undertake other actions which are related to EUGIN's objectives and which should assist in their realisation.

Currently, the members of EUGIN are the twelve national institutes of navigation from: Austria, Germany, France, Italy, Spain, Switzerland, United Kingdom, Sweden, Sweden, Finland, Norway, Denmark, Netherlands, Portugal, and Poland. The honorary members of EUGIN are Confederation of European Shipmasters Associations, Galileo Services, and UVS International. The European Group of the Navigational Institutes, from the time of its establishment in 1997, supports development of navigation and promotion of the contemporary solutions, necessary for navigation systems. Also EUGIN supports the national research centres, indicating trends of development of navigational positioning systems.

The whole navigational community is closely watching the development of RPAS-related technologies. Possible military and civilian applications indicate that unmanned systems can be „a milestone" in the development of safety of human activity. From the point of view of the implementation of navigation processes, contemporary RPAS constitutes a comprehensive measurement and decision-making system, with its basic elements such as positioning, land survey information, photogrammetric, teledetection and telemetric systems. The level of their technological advancement is a factor decisive for their capability and complexity of operations. It must be assumed that the target for their application is the execution of their mission in any space and in fully automated mode without any operator. Expanding the scope of their application from the navigational point of view is currently dependent on three basic factors: positioning systems feasible for utilisation in urban environment, which should provide almost 100% availability of positions, positioning systems inside buildings and structures, and spatial geographic information systems (GIS) describing the ambient world through a system of coordinates facilitating navigation among them. The capabilities of satellite to position RPAS in densely urbanised areas are determined today by the capabilities of their positioning systems to carry out measurements of the distance between the satellites and the GNSS systems in the environment, attenuating the signals by the screening buildings. The research has showed that the utilisation of GPS systems alone facilitates positioning at the maximum distance of 10-15 metres from the structures. As we get closer to the structures, a minimum number of satellites (i.e. four), which allows for obtaining coordinates of their position, cannot be provided.

Since 2011, the GPS system has been providing a constellation of satellites consisting of almost 30 units, making it possible to identify locations all over the globe. The estimated precision of GPS is at present 3 m (p=0.95) horizontally and 7 m (p=0.95) vertically, and it is steadily expanding. The full launching of the Russian satellite system GLONASS became a significant part of utilisation of GNSS from the RPAS navigation's point of view. Since December 2011, the system has gained its full operability, providing its signal's global availability at a level of 99.8%. At present (May 2014), there are 28 satellites available within the system, and potential precision of positioning is comparable to that of GPS. From the positioning point of view, future utilisation of integrated GPS/GLONASS receivers will offer a possibility of obtaining higher accuracy, and - first of all - signal availability in urbanised areas. It should be assumed that launching further satellite navigation systems, such as Compass and Galileo, up to the end of 2020, will solve a problem of RPAS positioning in urban locations.

Positioning inside buildings, where classical positioning solutions were inapplicable, has been a dynamically developing area for the last few years. A currently foreseeable direction of possible development is the application of emitters of so called 'beacons' located inside buildings at the spots of known coordinates, facilitating identification of the location in relation to their position on the basis of the signal's strength, measurement of distances, or a difference between them. Today, many manufacturers offer proprietary navigational solutions, available also for the PDAs, supporting location in large hypermarkets. It may be expected that the space insufficiently used by RPAS systems so far will be filled out by them in the future. However, the reception of geospatial information concerning them is a fundamental pre-requirement.

There is a lot to do in this area, i.e. in the geospatial information about the area outside and inside structures. Among many limitations, the lack of spatial models of the construction infrastructure, defined by the coordinates, seems to be most fundamental one. In the case of newly-built structures, using architectural designs made in vector technology, appended to the system of coordinates, seems a natural solution. The issue gets much more complicated in reference to older infrastructure, for which - naturally - such documentation does not exist. Laser scanning, as a quick and precise method of acquiring geospatial data concerning structures, has a decisive application potential. During the last few years, the efficiency of laser scanning operations increased from a couple of thousands to nearly a million points per second. In the nearest future, the development of aerial and mobile scanning technologies will impose the creation of GIS systems based on computed clouds of points, in which each of the structures will be composed of their sets, together with appended coordinates. It may be expected that the evolution of geographic information systems, from photogrammetric satellite imaging to vector maps, is going to enter a new stage, i.e. laser scanner imaging. A popular function 'Street View' available at the Google Earth portal, which is decisive today for general-access standards for geospatial information systems, may be replaced in the future by the solutions facilitating the presentation of data generated by laser scanning, acquired by mobile measuring stations, both land and airborne ones. As a result, not only construction infrastructure, but also its neighbourhood will have coordinates defining their geometrical shape and spatial location, together with their orientation.

Scanning of interiors of buildings performed for navigation purposes, resulting in the supply of their spatial description, may be efficiently carried out through RPAS. However, it is a long-term process. For example, a 3-4 storey building requires about a month of measurements (composed of some 200-300 changes in scanner locations) and 1 month of indoor analysis carried out by a team of several people.

As it has been mentioned above, 3 elements, i.e. satellite positioning based on multi-system navigational solution, development and standardisation of positioning systems within buildings, and acquiring and presentation of geospatial information concerning structures and their interiors, constitute major determinants for developing RPAS applications in urban areas.

Summing up, it must be assumed that within the next 5-6 years the number of available satellite positioning systems (GNSS) will double, thus bringing about a possibility of achieving sub-metre precision of spatial location in urban areas, providing at the same time a possibility of positioning at any point in a city. An analysis of development trends makes us conclude that the introduction of a single positioning system inside buildings may be solved within a decade, provided they are standardised. The most time-consuming element will be acquiring geospatial data of the infrastructure (particularly those referring to the interiors), which constitute map-oriented information for the future application of RPAS.

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