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# REMOTE AIRFIELDS NAVIGATION AND TOWER CONTROL THROUGH OPTICAL AND RADIO-FREQUENCY DATA FUSION

**Abstract**

The civil aviation operations safety is enhanced by the Air Traffic Control (ATC). While en-route control is usually managed by centralized Area Control Centers (ACCs), that can operate without visual monitoring the controlled aircraft, in-situ visual surveillance on the aircraft position is often applied in terminal air applications, i.e. by Air Traffic Control Towers (ATCTs) in airports. However, the high manpower costs for operating ATCTs are often not justified by the low and discontinuous number of flights arriving and departing from remote or small airfields. Therefore, the vast majority of world's airports are Non-Towered Airports (NTAs), only offering procedures for take-off and landing, without the assistance of ATCT operators. The Remote and Virtual Tower (RVT) concept has led, in the last years, to the possibility of performing terminal air space surveillance without the physical presence of ATCT controllers at the airfield, but with a complex remote surveillance system aimed at providing situational awareness to operators located in a separate site. A further leap forward in ATCT coverage for NTAs could be represented by an Automated Virtual Control Tower, consisting in a surveillance infrastructure in charge of autonomously processing optical and Radio-Frequency data, in order to monitor the nearby aircraft correct position and speed, to communicate with the ATC and to provide navigational instructions to the pilots. The system takes advantage of an optical segment, addressed at determining the aircraft angular position, and of a Radio-Frequency sub-system, capable of ranging and measuring the approach speed of the target. Finally, an information segment will provide guidance to the vehicles through an automated mechanical voice radio channel, as for actual ATCT controllers. The surveillance and navigation system has been designed by considering up-to-date and low-cost technologies, such as motorized telescope stations, wide-field commercial cameras and Software-Defined Radios (SDRs), that could allow a significant cost reduction in the production and implementation. The applicable technologies are currently used, with high maturity, for space surveillance and space debris tracking, allowing their adaptation to the ATC field with reduced development costs. This paper will describe the design of an Automated Virtual Control Tower and the achieved results on its sub-systems development. In particular, the technologies adopted and the similarities between their usage in the fields of space surveillance and aerial navigation and ATC will be outlined. Finally, the future perspectives, the completed tests and the possible applications to Unmanned Aerial Vehicles surveillance will be presented.