Assessment of Optical Markers for On-Board Autonomous Localization of eVTOLs during Landing

Finn Hübner, Stephan Wolkow, Andreas Dekiert, Maik Angermann, Ulf Bestmann
Institute of Flight Guidance
TU Braunschweig
Braunschweig, Germany
f.huebner [at] tu-braunschweig.de

Abstract— Knowing confidently and reliably your position is the basis for autonomous and safe operations of air taxis in the emerging urban air mobility market. Especially during landing satellite based navigation alone is not sufficient. Additional accuracy and integrity are required. Computer vision can profit from the information rich visual environment and is potentially suited to provide localization but algorithms need to adhere to the strict requirements in manned aviation. In this paper we propose an optical localization system on the basis of the artificial fiducial ArUco markers similar to QR-codes for the landing of eVTOLs. The proposed localization system consists of a landing pad design based on ICAO regulations enhanced with an arrangement of markers that should allow localization during approach at any height. The presented system was then evaluated in graphical simulations such as VTK and AirSim. Furthermore, we artificially induced errors into the detection algorithm to test for error detection and correction capabilities. Finally, small-scale real world experiments were conducted to verify our observations. We found that 2 meter sized markers can be detected from as far as 60 meters even under varying weather influences and that centimeter accuracy can be reached although the error increases with distance to the landing pad. Additionally, we can show the validity/suitability of the markers as trustworthy reference points, have reason to believe that detection errors can be compensated within the application and potentially detect integrity violations. While this study reveals the potential of the system and laid the basis for its practical and economic use, it is the starting point for the development of a holistic navigation system that will make use of additional environment information and needs to be verified by large scale real world tests..