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A multirotor platform for mapping and inspecting sub-vertical rock faces

Klaus Thoeni (1), Christopher Renton (2), and Anna Giacomini (1)

(1) Centre for Geotechnical and Materials Modelling, The University of Newcastle, Callaghan, NSW 2308, Australia, (2) Mechatronics, School of Engineering, The University of Newcastle, Callaghan, NSW 2308, Australia

Only in recent years UAS technology has become accessible to everyone and, hence, it is rapidly becoming a valuable tool for researchers and scientists (Westoby et al., 2012; Nex and Remondino, 2014). Electric multicopters (i.e. multirotor helicopters) are one of the most exciting developments of the last couple of years. Only the development and implementation of advanced flight controllers made the use of multicopters possible. Generally being an aerodynamically unstable UAS they absolutely require a flight controller for stable flight. Several open-source and commercial flight controller are now available which makes it possible to build custom UAS.

The current work presents a custom build hexacopter (i.e. a multicopter with six rotors) which was specifically developed for 3D mapping and inspection of sub-vertical rock faces. The main sensor installed on the platform is a Canon 100D DSLR camera. The camera is attached to a two axis gimbal. The roll angle is automatically controlled to keep the camera level during the flight whereas the user controls the tilt angle. The two forward facing arms of the hexacopter have been raised, i.e. they are located higher than the other four propellers (Mantis arms). This provides a clear field of view when looking forward and even makes it possible to look slightly upward without having the propellers in the field of view. A DJI A2 flight controller is installed on the platform and an additional FPV camera can be switched on if pictures are taken in manual mode. So far the flights are all performed in manual mode. The fact that the platform is generally flying very close to very irregular sub-vertical rock faces makes autonomous flights in GPS mode almost impossible. In addition, GPS reception is often very poor around sub-vertical rock faces. One main issue when flying in manual mode is to keep the hexacopter at a constant distance from the surface. As the rock surface gets higher and higher it becomes more and more difficult for the pilot to estimate this distance. Hence, some modifications are currently being implemented. A lightweight laser sensor will be installed to measure the distance between the drone and the sub-vertical rock surface in real time. The information will be transmitted to the pilot who can keep the hexacopter at the required distance. Some applications of the developed platform for the 3D mapping of highwalls in Australian coal mines are presented and the advantages over conventional methods (e.g., Thoeni et al., 2012) are discussed.

References

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