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Multi-rotor UAV as a natural disaster monitoring tool in Brazil

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In Brazil the use of drones has become popular in commercial and scientific sectors. In geosciences, however, this tool is yet little applied, being restricted to the initiative of some research institutes. One example is the brazilian Instituto de Pesquisas Tecnológicas of the State of Sao Paulo (IPT) that has been using small multi-rotor UAVs for mapping and monitoring of geological-geomorphological surface processes and for natural disaster and risk management.

Drones are an important tool for monitoring the evolution of geological-geomorphological process, allowing quick response, damage assessment and stability analysis, in places with limited access or that pose danger to the authorities. A working routine was created by the Institute, based on versatile tools, with low cost and easy-to-use. Popular commercial low-cost UAVs were applied, as well as free applications and softwares for flight planning and image processing, using mainly cloud services, allowing agility in data processing and in the obtention of its main products (orthomosaics and tridimensional models).

We use the DJI UAVs Phantom 3 and DJI Inspire 1, with conventional RGB cameras. For flight planning and execution, we use DJI Go application. As a protocol, we make a preliminary reconnaissance flight on the field above the area of interest to recognize its main characteristics, especially regarding topographic differences and vegetation heights, anticipating possible collisions and distortions on the products obtained. Images are then processed in a cloud web service (Precision Mapper), through which the orthomosaics and digital elevation models are obtained.

This routine allows the analysis and monitoring of geological-geomorphological processes, such as landslides, debris-flows and gullies evolution, allowing estimates of the volume of mobilized material, number of endangered houses and risk analysis associated with anthropic activities, such as mining, pipelines and landfills.

Up to now the main results obtained through this routine consist in the monitoring of two major landslides and the evolution of a gully, located in the state of São Paulo. Regarding the landslide cases, based on the orthomosaic and the DEMs, we obtained the scar area and perimeter, extension of damages, volume of the mobilized material and its possible evolution. As for the gully monitoring, we obtained the volume of mobilized material and identified the morphologies associated with the process evolution for posterior analysis and monitoring.

The use of drones in emergency and geomorphological disaster management has so far been very satisfactory, allowing the support of field teams, agility on data acquisition, damage analysis, evaluation of process evolution and the monitoring of potential instability conditions, allowing more fast and assertive decision making.

However, there are limitations and challenges that need to be overcome, such as the presence of dense vegetation, of special importance in the humid tropics, pointing out the need of replacing conventional RGB cameras for sensors that penetrate the vegetation, like LiDAR. Also, the limited availability of free data and the cost of sensors in Brazil are other important limitations to the diffusion of this technology, even though its adoption is inevitable considering the various advantages that it presents.