

Drones (UAV's) in mining and exploration. An application example: Open-pit geology mapping and 3D geological modelling

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The name drone, for the wider public, generally refers to an Unmanned Aerial Vehicle (UAV) in military applications. Commercial drones are however light (1-5 kilograms) and small-sized (0.3-1 metres) remote controlled aerial vehicles made of plastic or carbon fiber and capable of carrying 0.5-10 kilograms payload. They are generally electric motor-driven and have four- (quadcopter), six- (hexacopter) or eight- (octocopter) propellers or they have the body of a miniature airplane (fix-winged design). Drones are getting a lot of attention in mainstream media in the past few years and have numerous commercial applications; most commonly aerial filming and photography, industrial quality control, search-and-rescue, security, safety, anti-poaching and trial postal delivery systems.

Commercial drones are also a new toolbox of innovative methods for transforming mining companies as a response of huge market change in recent years. Typical applications of drones in the mining industry include; aerial surveying, stockpile management and surveillance of mining installations, leach pads etc.

The application of drone photogrammetry for aerial surveying is also a rapidly developing field in science, natural resource management and mining. This method was first described by Eisenbeiss 2009 for photogrammetry computer processing of images acquired by a digital camera attached to a small commercial drone. Since then numerous researchers have used drone-based photogrammetry for geological mapping of outcrops (Vollgger & Cruden 2016, 2014, Bemis, et. al, 2014, Vasuki et al., 2014).

However reports on using drones for pit mapping and geological modeling in open-cut mines are still rare (Szentpeteri et al., 2016), probably because it is still an ongoing in-house development program for most mining companies.

In this paper we summarize our results using a miniature low cost consumer drone; a quadcopter in open pit mining environments to create high-resolution pit and bench maps and 3D photo-realistic geological models. The models are integrated into state-of-the-art 3D geological modeling software platforms. We demonstrate how first order geological features, on the deposit-scale, can be mapped and digitized into geological models from drone mapping i.e. in orogenic gold- and high-sulphidation epithermal gold-deposits. Our emphasis however is to demonstrate how to collect and integrate meaningful geology i.e. structural, alteration and lithology data from these Drone-generated 3D models. Such drone models can supplement typical geological tasks in open pit mining environment such as pit surveying, geotechnical surveying, geological and structural mapping, bench mapping and various other tasks.

We also summarize the current development of software and hardware available to date to carry out drone surveys and process its data and how to transfer data into geological 3D modeling software packages. Furthermore we highlight the future possibilities of Drone technology in mining from geology to geophysics and beyond.