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A Student-Led Project for the Design of an Imaging CubeSat Payload

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Volcanic ash presents a challenge for the aviation industry. Volcanic ash is semi-transparent, absorbing in the 8-12 micron window. 3D information is needed to be able to back-calculate dose – this is a key parameter in managing airspace. To recreate the ash cloud, multiangle observations are required – making a nadir-pointing satellite ideal to perform observations for this purpose. Other mission objectives using the same instruments can also be realised, for example, as volcanic ash clouds are the primary target, there is the possibility to map new magma extrusions, lava and pyroclastic flow movements. Thermal infrared data has also previously been used to observe volcanic cycles and better understand their behaviour. There is also the possibility of including forest fires as targets of opportunity. The images required for 3D construction of ash clouds can also be used to create digital elevation models of terrain around volcanos which have application in disaster management and planning.

A CubeSat mission - Pointable Radiometer for Observing Volcanic Emissions (PROVE) - is proposed to monitor the ash cloud using both thermal infrared and visual cameras. All requirements and components were determined by students through trade-off studies. Each work package was undertaken by undergraduate and postgraduate students (both as part of research projects and on a voluntary extracurricular basis) supervised by academics. The resulting 1U+ payload consists of a thermal infrared camera (FLIR Tau 2 with a 50mm lens), and 2 visual cameras (a narrow field of view Basler ace ac5472-5gc with a Kowa LM75HC lens, and a 5MP Arducam with a 40 degree lens as a wide field of view instrument). Alongside this, a payload computer to communicate with the cameras and store data was selected (the Beaglebone Black Industrial) with a custom PCB providing connections to the instruments and bus. The software to operate the payload takes the form of a custom scheduler for an imaging pass, sending commands to the camera systems (and to the bus) to take the required multiangle images for ash cloud reconstruction.

The payload is currently in the final design and testing stage, with vibration and vacuum testing, as well as FlatSat testing before the final manufacture and integration of the payload. There is the possibility of a UK launch later this year.