Development of an Imager for CubeSatellites

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Description: Cube Satellites (CubeSats) are based on standard 10x10cm^3 building blocks and are pushing the boundaries of the use of high-technology in new space applications. Originally used to train engineers and scientists and to demonstrate technology, many teams around the world are looking into the uses of CubeSats to perform low-cost science experiments in space.

The Centre for Electronic Imaging has successfully flown two imaging payloads on UK national CubeSats; UKube-1 and AlSat-Nano which have both returned images of the Earth, and have proven the new CMOS imaging technology in space thereby raising its "Technology Readiness Level" (TRL). These results have already benefitted Teledyne-*e2v*, the CEIs key industrial collaborator, who are now providing the CMOS sensors into new space applications. The PhD programme would be aimed at developing our understanding of the operation of such CubeSat payloads in space based on the results from our existing payloads, and in developing a new imaging payload for use on a CubeSat which would be responsive to launch opportunities arising during the period. An initial outline of study topics is provided below.

- Radiation modelling: To perform a research study into space radiation in the CubeSat environment. Here the student would analyse data from the RADFET dosimeters on our existing C3D2 instrument on AlSat-Nano which is accumulating data on the total ionising dose (TID) with samples being taken at two points on the spacecraft. The student will then explore ground calibration of the RADFETs, and build a detailed 3D models of the spacecraft and particularly the local material and shielding around the dosimeters, using ESAs SPENVIS and CERNs Geant4 tools. The models will be iterated toward matching the modelled TID with the estimates from the electronic dosimeters currently in-orbit. This work will help build an understanding of key sensitivities for spacecraft shielding, and understanding dosimetric errors (arising from temperature, dose rate, settling and annealing effects) and uncertainties in such instruments, and to enable the student to translate the methods to much more complex (and expensive) space instrumentation.
- Image Sensor Research: Our C3D imaging payload uses a 1.3 Mpixel commercial sensor, and this has now achieved TRL9 through our C3D instrument. However, during testing we identified that these sensors were relatively soft to single event and latchup effects (SEE/SEL) arising from particle interactions. Since developing the first payload in 2012, e2v have developed new products with up to 16 Mpixels. These newer sensors may be applicable to a range of new instrumentation, and the student will explore use of new, higher resolution sensors for use in the space environment, particularly focusing on their sensitivity to SEE and TID (linking to item 1 above). The benefits of using these new sensors would be explored for different applications.

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- Instrumentation development: The CubeSat standard enables development of miniaturised instrumentation using state-of-the-art technology which can provide performance enhancements over more traditional space-qualified technology. The student will explore the development of a new CubeSat imaging instrument; with initial prototyping based on the CubeSat platform, building upon our existing C3D and C3D2 experiments on Ukube-1 and AlSat-Nano. However, the work will also consider possible use or exploitation of the instrumentation in future space science and other mission opportunities, for example for Rovers (e.g. the ExoMars PanCam or NavCam types of application) and deployment monitors. We anticipate the output of this work to take advantage of any flight opportunities on new CubeSats in the short-term.

We seek a highly motivated candidate with an interest in space science applications, physics, electronics, and engineering, with a willingness to participate in research and development of instrumentation for future CubeSatellites. The successful applicant will work in a dynamic research team consisting of ~20 PhD students and post-doctoral researchers.

Qualifications required: A first class or upper second class Masters or Bachelors degree (preferably with relevant additional experience) or equivalent in Physics, Electronic or Mechanical Engineering is required.