

My engineering hobby... Putting insects in focus

Retired railway engineer Mike

Hawkridge likes to take photographs of small things, such as insects and mould, and has designed a focus-stacker to obtain images with a much larger depth of field.

"One of the problems of photographing small things is the very limited depth of field that a macro lens will provide, even stopped down to a small aperture," Hawkridge explains.

"The solution to this is to take a series of images at different distances from the subject and merge the parts of each image that are in focus using special software to make a final image that is all in focus. This can involve taking hundreds of images at increments measured in microns, something that clearly benefits from precision and automation.

"A focus-stacker will move the camera in very small increments towards the subject, and these you can purchase, but they are not cheap; I thought it would be much more interesting to design and build one – and cheaper."

Hawkridge's focus-stacker is based on a DVD drive, which provides the mechanism that controls the tracking of the laser, and is driven by a new stepper motor controlled by a Raspberry Pi via a dedicated control module. The Pi also controls the camera and provides status indications.

He says: "The biggest part of the



project was programming the Raspberry Pi. My application runs to well over 1,000 lines of code, partly because I wanted a nice Windows graphical user interface and all the options I could imagine.

"I had to teach myself to programme in Python. In the end I opted to interface the Pi with an old laptop for its screen and keyboard, via the Pi's network port."

Hawkridge's system can achieve magnification up to 10:1. Magnification of 10X uses a 10X infinity microscope objective mounted on a 200mm telephoto lens and steps of about 5 microns or less; a typical sequence of 200 images will take 30 minutes or so to execute. "It was everything I hoped for and has produced very acceptable results," he adds.

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