Low-cost 3D Imaging
3D images of real world objects are desirable in many applications such as prototyping, quality assurance and security. SPC offers real advantages in 3D ranging application due to its exquisite timing resolution.

Working with Leonardo (formerly Finmeccanica-Selex E5 Ltd) we have adapted our Single Pixel Camera (SPC) to provide range information for every single element in an image in addition to a standard two-dimensional image.

In essence a SPC resembles a data projector where the light source is replaced by a single element (pixel) detector which measures the total power transmitted through the display as superimposed upon the scene. By displaying a known series of complex masks and measuring the transmitted power associated with each mask, it is possible, by data inversion, to deduce the image of the scene (see Edgar et al. Scientific Reports, 5:10909, 2015).

Unlike a conventional camera, where each pixel in the detector measures only the intensity, a SPC offers real advantages in 3D ranging application due to its exquisite timing resolution. When the SPC is combined with a pulse illumination source, the return signal has a complicated spatial profile dependent upon the 3D form of the scene. The data can then be inverted to obtain the full 3D information.

This method allows very interesting applications where information can be selectively collected from one part of the scene, allowing the camera to view through semi-transparent screens, such as clothing or tree canopies. A surprising feature arises from the complexity of the data collected: this technique achieves a depth precision that exceeds the timing resolution of the detector.

At a range of 1-10m we have produced 3D imaging with a depth resolution of mm precision and a frame rates between 1 and 10 frames per second. Our challenge for the next stage of the project will be to adapt the system into the infrared for covert illumination and to increase the data collection to obtain near-video display rates.

<table>
<thead>
<tr>
<th>Application area</th>
<th>Low cost range-gated imaging for 3D ranging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Component Cost</td>
<td>As laboratory demonstrator ≈ £10K  In volume &lt; £500 (componentry similar to commercial digital light projector)</td>
</tr>
<tr>
<td>Present Performance Specs</td>
<td>Resolution and frame rate: 32x32 @ 8 FPS, 64x64 @ &gt;2 FPS, 128x128 @ 0.5 FPS Approximate imaging sensitivity (in plane of DMD): 0.1 µW/cm² Camera size: 600 x 400 x 200 mm</td>
</tr>
</tbody>
</table>

For more information, please contact:

Dr Michael Fletcher
QuantIC Business Development Manager
michael.fletcher@glasgow.ac.uk

Professor Miles Padgett
Project Technology Lead
miles.padgett@glasgow.ac.uk

www.quantic.ac.uk
@QuantIC_QTHub