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Initial MFAA Nearfield measurements using a UAV platform

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Characterisation of array beam patterns is a necessary part of radio astronomy calibration. Well known beam-patterns can significantly increase the dynamic range of observations. Far-field measurements using unmanned aerial vehicles (UAV's) have already proven to be useful in validating the performance of real-world aperture arrays beam patterns. These measurements focused solely on principle far-field cuts. However, measuring the full 3D embedded element pattern in a Far-field regime requires a high amount of flight time to cover the full semi-hemisphere. Alternatively, near-field measurements require a significantly smaller surface area to extract the full embedded element patterns. This is because the UAV only needs to fly planar flight pattern three wavelengths above the array. The extent of the planar surface is constrained by the beam-width of the antennas under test.

This work reports on the initial nearfield measurements made on the Cambridge sixteen element mid-frequency aperture array. The measurements are made using a purpose-built platform called Flying Electromagnetic Metrology Unit (FEMU). FEMU contains a dual polarised source enabling both polarisations to be measured during the same flight. Laser altimetry and real-time kinematic RTK GPS is used to increase the accuracy of position logging.

The high-frequency requirements of the MFAA make phase synchronisation between the UAV and antennas impractical leading to magnitude only measurements. The measured near-field magnitude is compared to full-wave simulations to assess the array performance. Phase extraction is also attempted using a secondary measured plane offset from the initial measurement. If phase extraction is successful, the measured data can be transformed into individual full 3D embedded far-field patterns for all the antennas.