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A beam steering phasing box for flexible SuperDARN radar operations

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SuperDARN radars rely on a ~228.6-m linear array of 16 log-periodic horizontally polarised antennas to form a main broadside beam of half-power full-width ~4° at 12 MHz. A phasing matrix provides the frequency independent time delays required to steer the main beam in sixteen directions separated by 3.24° to form a field of view (FoV) ~52° wide in azimuth. A fixed boresight is chosen during construction because changing the design of the antenna array and phasing matrix is impractical. The boresight is usually chosen to optimise the scientific capabilities of each radar, but a single boresight does not always satisfy every scientific requirement. We present the design of a compact beam steering phasing box which can be switched into series with the phasing matrix, thereby rotating the boresight and FoV of the radar by a pre-determined amount. The switching is accomplished under software control in the command line argument of a radar control program. In the first instance, we illustrate the performance of a phasing box designed to rotate the TIGER Bruny Island (43.4°S, 147.2°E; 55°Λ) FoV by 9.3° towards the east, thereby placing beam 14 directly above Macquarie Island (54.5°S, 158.9°E; –65°Λ). Theoretical, phased array antenna patterns and the results of discretionary campaigns will be shown. We will also discuss future experiments using other planned phasing boxes. Finally, we recommend our system as an economic, versatile way of changing the antenna phasing, but note that this versatility would be inherent to a fully digital implementation of SuperDARN radars.