RCS measurements of LEO objects using the BPST radar

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In January 2020 two defunct satellites, IRAS and GGSE-4, nearly collided, with an estimated miss distance of twelve metres. As the near future of the space industry will give rise to numerous mega constellations of thousands of satellites, and as launch costs have been steadily decreasing, there is concern that the increased use of space will lead to an increase in the risk of collisions. This has led to an increasing interest in space situation awareness (SSA), which has motivated investigation of the use of non-traditional sensors for space surveillance, such as HF and VHF radars. In the context of the Australian Defence Force, this is illustrated through Joint Project 9351 for the development of indigenous space sensors, and through the conduct of three recent Defence trials (SpaceFest 2018, 2019 and 2020) to evaluate the use of non-traditional indigenous sensors at Woomera, South Australia.

The Buckland Park 55 MHz VHF stratosphere-troposphere (BPST) radar is a low-cost meteorological wind profiling radar that was designed specifically to measure tropospheric and stratospheric winds (0.5 - 20 km), but has been successfully used for SSA observations of low Earth orbit (LEO) objects. This paper presents results from the latest campaigns to help understand the full capabilities of the radar.

Work has been performed to calibrate the radar to measure radar independent parameters such as the radar cross section (RCS) of each observed object, which is not well understood at VHF. The results potentially allows investigation of ionospheric/plasma effects or the spacecraft wake upon RCS. Recent campaigns have also investigated the combined meteorological and space object detection observations which could allow collateral use of VHF radars for space object detection. Additionally, work has been performed to distinguish RCS aspect and ionospheric effects. Future work will also investigate the extraction of ionospheric parameters such as TEC from these observations.