The Precision Expandable Radar Calibration Sphere (PERCS)

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High frequency (HF) radars are used to detect ionospheric irregularities, meteor trails and moving targets. The Precision Expandable Radar Calibration Sphere (PERCS) is a simple radar target in space to help determine the operational parameters of ground HF radars. PERCS will have a known radar cross section that is independent of observation direction within 0.5 dB. The PERCS satellite can be launched in a stowed configuration that has about one meter in diameter. After launch, the PERCS will expand to a diameter of almost 10 m. Upon expansion, a stable wire-frame is formed to act as a radar scatter target in the form of a polyhedral sphere. The simplest version of the sphere has 60 vertices (V60) that are joined to 90 rigid segments. Each segment is hinged so that the PERCS can be folded into a compact package for launch. Analysis of the V60 wire frame with a 10 meter diameter shows that the radar cross section (RCS) is nearly independent of viewing angle up to 30 MHz. Another design with 240 vertices produces even better performance. Radar systems will be calibrated using the radar echo data and the precise knowledge of the target RCS, position, and velocity. The PERCS can reflect radar signals from natural targets such as field aligned and current driven irregularities not presently accessible from ground based radars. The wire frame structure has several advantages over a metalized spheroid "balloon" with (1) much less drag, (2) larger radar cross section, and (3) lower fabrication cost. The performance specifications for specific HF radars and radio transmitters are examined to determine there ability to detect the PERCS in low earth orbit. The SuperDARN HF radars and the ionospheric heaters in Alaska (HAARP and HIPAS) and Norway (EISCAT) and the rebuilt heater in Puerto Rico (Arecibo) will all be capable of using PERCS for antenna and system calibrations.