Commanding Cassini Radar for the Imaging of Titan's Surface

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We have investigated the dependence of Cassini radar performance on pulse repetition frequency (PRF) and incidence angle for Synthetic Aperture Radar (SAR) imaging of Titan's surface. The Cassini radar has 5 beams which are used sequentially and whose 3dB beam widths are about 0.35 deg x 1.5 deg, except for the central beam of 0.38 deg x 0.38 deg. To make imaged areas of Titan's surface usable, it is necessary for each image pixel to have signal-to-noise ambiguity ratio higher than +14 dB and a thermal noise equivalent backscatter cross-section lower than −10 dB. Using the Doppler sharpening technique, we expect the Cassini radar to achieve an imaging resolution of 300 x 500 m^2 in the along track and cross track dimensions at low altitudes (< 2000 km) and 600 x 1000 m^2 at high altitudes (> 2000 km). For a typical Titan flyby pass for SAR imaging, the orbit of the Cassini spacecraft is hyperbolic with its lowest altitude of 950 km at the closest approach. As a result, the range from the Cassini radar to Titan's surface varies widely and continuously with time. This in turn requires PRF and incidence angle to be adjusted with time in order to maximize the usable area. We have simulated the performance of the Cassini radar by examining the contiguity of usable image area and by measuring the number of looks. Our preliminary studies show that at low altitudes incidence angle can be increased up to 30 deg and PRF up to 5-6 KHz while low incidence angles of less than 20 deg and low PRF of 3-4 KHz are preferred at high altitudes. The number of looks is 3-4 at low altitudes and approaches 10 at high altitudes. We will show the results of parameter studies and the resulting performance variation.