Ultra-precise VLBI tracking of the Huygens Probe in the atmosphere and on the surface of Titan

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Very Long Baseline Interferometry (VLBI) technique exploits the fundamental principles of optics to achieve ultimately high angular resolution in detecting signals from remote celestial sources. It has a long and successful record of precise tracking of deep space missions. Owing to the higher data rates, lower noise temperatures of radio telescopes, advanced data processing equipment and algorithms the technique enables VLBI tracking of distant planetary missions in the outer Solar System. Recently, this potential has been demonstrated by VLBI tracking of the Huygens probe during its parachute descent in the atmosphere and after touch-down on the surface of Titan. The experiment was conducted on 14 January 2005. It involved 17 radio telescopes located in Australia, China, Japan and the United States, the Data Processing Centre in the Netherlands, and advanced high-capacity data transfer networks in Australia, Canada, the US and Europe.

The experiment enabled determination of the position of the Huygens Probe in the framework of background extragalactic radio sources with sub-milliarcsecond accuracy (equivalent to a km-scale linear accuracy at the distance to Titan). The experiment has also provided additional data for the reconstruction of the vertical wind profile in the atmosphere of Titan. Initial results of Huygens VLBI tracking will b e presented. Synergies between the radio astronomy support to the mission and other components of the Huygens science package will be underlined. Prospects of VLBI technique applications for tracking future planetary and deep space missions using the next generation of Earth-based radio facilities will be briefly discussed.