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VLBI for Geodesy, Astrometry, and Navigation

Megan C. Johnson[(1)], and Bryan N. Dorland[(1)]
(1) United States Naval Observatory, e-mail: megan.johnson@navy.mil; bryan.n.dorland.civ@mail.mil

Very Long Baseline Interferometry (VLBI) is the cornerstone for geodesy, astrometry and determining Earth's orientation within the inertial reference frame, and has been for more than 40 years since it was originally developed. VLBI is the only method currently available for measuring the rotation of the Earth precisely; these measurements are required because this rate is constantly changing and as such, it must be measured every day. VLBI is essential for understanding the Earth's orientation, position, and path around our star with respect to all other bodies within our solar system, Galaxy, Local Group, and the Universe. In addition, VLBI is used to define, quantify, improve, study, and maintain the celestial reference system and the reference frame, the foundation for the coordinate system for celestial objects (i.e., right ascension and declination).

In this talk, we present an overview of how VLBI contributes to geodesy today and what the future plans are for a next generation of radio interferometry network of antennas designated to studying geodesy in unprecedented precision. This next generation network, known as the VLBI Global Observing System (VGOS), is an international collaboration with a United Nations-sponsored mandate to map each station position to 1 mm in accuracy. This will enable studies of climate change in all regions of the planet, monitor plate tectonics in an unparalleled fashion, and study the structure and deformations of the Earth's crust, mantle, and core, as well as understand the magnetic coupling between the inner and outer cores.

In addition, we will discuss how VLBI has made navigation of and communication with distant spacecrafts possible. In fact, the Voyager spacecrafts, which were launched in 1977 and are now more than 10 billion miles from Earth, are still actively in communication with a global network of 70-meter antennas known as the "Deep Space Network" (DSN). These antennas are able to send and receive radio signals to and from the Voyager spacecrafts in order to track and communicate with the probes, and are also used both to map out the celestial reference frame as well as navigate satellites such as Voyager on their deep-space missions.