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ORBIT DESIGN AND UV COVERAGE FOR TWO-SATELLITE SPACE VLBI

Abstract

When making observation of astronomical radio source by radio telescope, large aperture antenna is always preferred in order to have high spatial resolution. However, the physical size of an antenna is limited when the aperture requirement is larger than a few hundred meters in microwave band. Fortunately, this problem can be overcome by aperture synthesis or interferometry technology, where an array of small-size antennas is employed to achieve large aperture that is comparable to the array size. The straight lines between any of the two element antennas in the array are called interferometrical baselines. The multiplications of the coherent signals received from the two antenna/receiver channels on one baseline are called the correlation measurements, or spatial-frequency samples, i.e. the uv samples. For the Very Long Baseline Interferometry (VLBI), the baseline lengths are commonly thousands of kilometers and the array is extremely sparse with only a few elements. Global VLBI arrays with international cooperation now routinely make observations with a spatial resolution equivalent to that achieved by a radio telescope as large as the dimension of the Earth. For further overcome the limitation of the Earth, space VLBI is proposed and implemented with baselines between antennas on the spacecraft and that on the ground.

One important factor to influence the quality of a ground VLBI image is the uv coverage provided by both the baselines formed by the ground radio telescopes and the rotation of the earth. For Space VLBI, if two spacecrafts are used instead one, the quality of the image will be greatly determined by the orbit design of the two spacecrafts.

In this presentation, the orbit design of a two-satellite space VLBI is discussed. Two design examples are given with different priorities. The first design is given with more emphasize on the uv coverage by the two spacecrafts. The second design is given with more emphasis on the baselines between the spacecrafts and the ground telescopes. The refresh time of a complete uv coverage and the image sensitivities of both designs are also discussed.