

From Earth Missions to Deep Space Exploration (05)  
Exploration Research and Technologies (2)

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## RELATIVISTIC POSITIONING SYSTEM BY MEANS OF PULSATING SOURCES FOR NAVIGATION FROM THE SOLAR SYSTEM TO DEEP SPACE

### **Abstract**

We introduce an operational approach to the use of pulsating sources, located at spatial infinity, for defining a relativistic positioning and navigation system, based on the use of null four-vectors in a flat Minkowskian spacetime. We describe our approach and discuss the validity of it and of the other approximations we have considered in actual physical situations. As a prototypical case, which is relevant for Deep Space navigation, we show how pulsars can be used to define such a positioning system: the reception of the pulses for a set of different sources whose positions in the sky and periods are assumed to be known allows the determination of the user's coordinates and spacetime trajectory, in the reference frame where the sources are at rest. In order to confirm the viability of the method, we consider an application example reconstructing the world-line of an idealized Earth in the reference frame of distant pulsars: in particular we have simulated the arrival times of the signals from four pulsars at the location of the Parkes radiotelescope in Australia. After pointing out the simplifications we have made, we discuss the accuracy of the method. Eventually, we suggest that the method could actually be used for navigation across the Solar System and be based on artificial sources, rather than pulsars.