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Optical and Radio Calibration of the Repealite Based Indoor Positioning System

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ABSTRACT

In order to achieve indoor positioning, and hence a real continuity of the positioning service in all environments, we proposed a new pseudolite-based system: the repealites. A single GNSS-like signal is transmitted from all the repealites (typically 4 for 3D positioning): this approach simplifies both the synchronization process (between transmitters) and the indoor interferences between pseudolites. In addition, in order to avoid intentional artificial multipath, the signals from two repealites are shifted in time by a few chips.
The time shifts and the links from the central command and control electronic centre (where the signal is generated) and repealites are carried out with optical fibers in order to reduce size and power losses. There is then a need for calibrating the various induced delays (time shifts and links).
Two methods are fully described in the paper. The first one will serve as reference and is based on optical measurements: the basic idea is to transmit low frequency radio signals over the fiber, from hundreds of kHz to a few MHz, depending on the length one has to measure, and to carry out differences of phase measurements. This leads to length determination accuracies in the range of a few centimeters for up to 600 meters of fiber.
The second method described is based on the auto correlation function (ACF) of the composite signal received at a GNSS receiver's end. The principle is to connect the radio outputs of the repealites directly to a combiner being connected to the receiver. In such a case, the ACF has as a number of main peaks corresponding to the number of repealites and measurements of the distances between peaks give the corresponding time shifts.
The comparisons between the two methods lead to both reference and receiver uncertainties concerning the proposed repealite based approach.

KEYWORDS: Continuity of positioning, Indoor positioning, Pseudolites, Repealites, Calibration.