A novel procedure for in-field calibration of sourceless inertial/magnetic orientation tracking wearable devices

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Abstract: Recent research in the emerging field of Phenomics aims at developing unobtrusive and ecological technologies which allow monitoring the behavior of infants and toddlers. Orientation tracking devices based on accelerometers and magnetometers represent a very promising technology since orientation in 3D space can be derived by solely relying upon the direction of the natural geomagnetic and gravitational fields which constitute an absolute coordinate frame of reference, i.e. sourceless. Many commercially available devices allow on-board calibration by means of addition of external circuitry, mainly used to generate artificial fields which act on the sensor itself as a known forcing input. Addition of external circuits is a major drawback in applications such as the one of interest, where the technology has to be worn by infants. When external fields, (e.g. gravitational and geomagnetic fields) are present, alternative calibration techniques are possible which rely on predefined orientation sequences of the sensor. In standard procedures, prior knowledge of the external field (magnitude and direction) as well as accuracy in performing the predefined orientation sequences contribute to determine the calibration parameters. In this work, a novel procedure for in-field calibration of magnetometric sensors is presented which does not rely on previous knowledge of magnitude and direction of the geomagnetic field and which does not require accurately predefined orientation sequences. Such a method proves especially useful in clinical applications since the clinician is no longer compelled to execute accurate calibration protocols.
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