Indoor Pedestrian Localisation Solution based on Anemometery Sensor Integration with a Smartphone

Guillame Trehard, Mehdi Boukallel and Sylvie Lamy-Perbal
CEA, LIST, Sensorial and Ambient Interfaces Laboratory
91191 – Gif-sur-Yvette CEDEX, FRANCE
mehdi.boukallel@cea.fr, sylvie.lamy@cea.fr

ABSTRACT

Nowadays, we are experiencing an increasing demand for indoor pedestrian localisation services. Ultimately, indoor localisation based technologies have to be ubiquitous, fading into the background, cost effective and naturally supported by nomadic devices. The indoor context has been addressed mainly by pre-installed infrastructure solutions (GNSS, Wifi…). Even if these solutions are smartphone oriented with sub-meter accuracies, they require large amounts of infrastructure to be installed into the environment. Those observations have led to the recent emergence of infrastructure-less solutions based on a range of technologies including inertial, camera and magnetometry. However, developed solutions remain computationally expensive and suffer from a lack of scalability.

The paper deals with the design, the calibration and experimental validation of a novel infrastructure-less solution dedicated to indoor pedestrian localisation issues. The approach involves aerodynamic fluid computation for instantaneous speed estimation of a pedestrian handling a smartphone. For this purpose, a differential MEMS hot wire anemometer is integrated to an Android smartphone by means of a dedicated ARM 32 bits controller. Pedestrian orientation measurements are ensured by the embedded sensory of the smartphone. Consequently, both instantaneous speed and direction measurements are combined to the dead reckoning technique for estimating the 2D relative position of the user.

Theoretical modeling from Navier-Stokes equations has been conducted in order to catch the fluid dynamics experienced by the anemometer. A dedicated embedded computational algorithm has been developped in order to ensure accurate signal processing, sensor fusion and position estimation. We have conducted extensive experiments in order to validate the efficiency and the robusteness of the adopted approach in a wind tunnel and different indoor configurations.

The conducted theoretical modeling emphasizes good accordance with the experimental part. In situ experiments demonstrate that the sensor augmented smartphone achieves pedestrian localisation with a repetable accuracy of 1 to 2 meters in 2D enviroment.

KEYWORDS: Indoor pedestrian localisation, infrastructure-less solution, sensor augmented smartphone, localisation based service, smart sensors.