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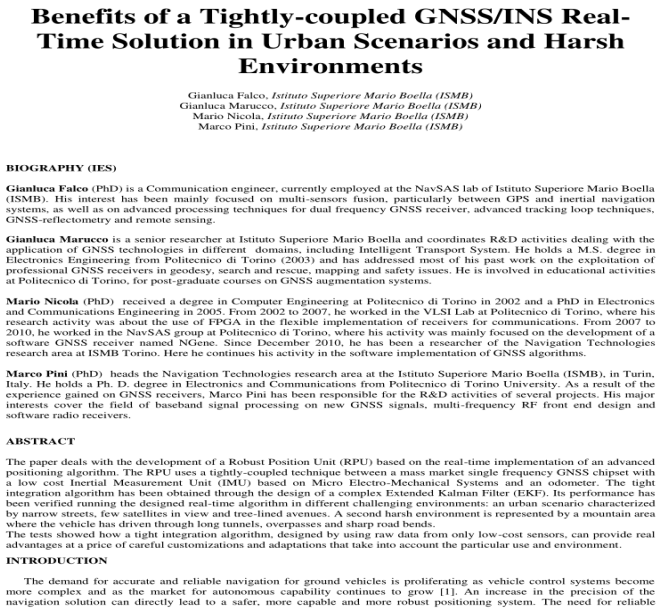

Benefits of a Tightly-coupled GNSS/INS Real-Time Solution in Urban Scenarios and Harsh Environments

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BIOGRAPHY (IES)

Gianluca Falco (PhD) is a Communication engineer, currently employed at the NavSAS lab of Istituto Superiore Mario Boella (ISMB). His interest has been mainly focused on multi-sensors fusion, particularly between GPS and inertial navigation systems, as well as on advanced processing techniques for dual frequency GNSS receiver, advanced tracking loop techniques, GNSS-reflectometry and remote sensing.

Gianluca Marucco is a senior researcher at Istituto Superiore Mario Boella and coordinates R&D activities dealing with the application of GNSS technologies in different domains, including Intelligent Transport System. He holds a M.S. degree in Electronics Engineering from Politecnico di Torino (2003) and has addressed most of his past work on the exploitation of professional GNSS receivers in geodesy, search and rescue, mapping and safety issues. He is involved in educational activities at Politecnico di Torino, for post-graduate courses on GNSS augmentation systems.

Mario Nicola (PhD) received a degree in Computer Engineering at Politecnico di Torino in 2002 and a PhD in Electronics and Communications Engineering in 2005. From 2002 to 2007, he worked in the VLSI Lab at Politecnico di Torino, where his research activity was about the use of FPGA in the flexible implementation of receivers for communications. From 2007 to 2010, he worked in the NavSAS group at Politecnico di Torino, where his activity was mainly focused on the development of a software GNSS receiver named NGene. Since December 2010, he has been a researcher of the Navigation Technologies research area at ISMB Torino. Here he continues his activity in the software implementation of GNSS algorithms.

Marco Pini (PhD) heads the Navigation Technologies research area at the Istituto Superiore Mario Boella (ISMB), in Turin, Italy. He holds a Ph. D. degree in Electronics and Communications from Politecnico di Torino University. As a result of the experience gained on GNSS receivers, Marco Pini has been responsible for the R&D activities of several projects. His major interests cover the field of baseband signal processing on new GNSS signals, multi-frequency RF front end design and software radio receivers.

ABSTRACT

The paper deals with the development of a Robust Position Unit (RPU) based on the real-time implementation of an advanced positioning algorithm. The RPU uses a tightly-coupled technique between a mass market single frequency GNSS chipset with a low cost Inertial Measurement Unit (IMU) based on Micro Electro-Mechanical Systems and an odometer. The tight integration algorithm has been obtained through the design of a complex Extended Kalman Filter (EKF). Its performance has been verified running the designed real-time algorithm in different challenging environments: an urban scenario characterized by narrow streets, few satellites in view and tree-lined avenues. A second harsh environment is represented by a mountain area where the vehicle has driven through long tunnels, overpasses and sharp road bends.
The tests showed how a tight integration algorithm, designed by using raw data from only low-cost sensors, can provide real advantages at a price of careful customizations and adaptations that take into account the particular use and environment.

INTRODUCTION

The demand for accurate and reliable navigation for ground vehicles is proliferating as vehicle control systems become more complex and as the market for autonomous capability continues to grow [1]. An increase in the precision of the navigation solution can directly lead to a safer, more capable and more robust positioning system. The need for reliable

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