GPS and MEMS: high positioning integrity

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***Abstract*- In this paper, we present GPS and MEMS positioning techniques and limitations. We suggest an original approach for high positioning integrity combining GPS and MEMS. This work has been made in the LoCoSS project context [1], which focuses on the localisation improvement of firemen.**

I. INTRODUCTION

Precise firemen localization in intervention is very important. This information allows rescuing quicker firemen in difficulties. Usually GNSS receivers are used to obtain positioning information. But the environment (forest, maritime, urban, indoor) can degrade the localisation integrity. The first part of this paper deals with the GPS integrity study and the environment influence. Then we present a positioning technique based on MEMS measurements. Finally, we interest on GPS and MEMS fusion in order to increase the localization integrity independently of the environment.

II. GPS INTEGRITY

GPS is a well known positioning technique and actually the more used [2]. But, GPS localisation presents bad integrity when there isn't enough observable satellite (urban canyon), or when GPS signals are attenuate (in forest). So we study environment influence on GPS signal reception and GPS localization integrity. These studies have been realized by simulation with ERGOSPACE (GNSS signal software) which allows introducing different environment as urban area [3], maritime [4] or forest model [5].

Then simulations have been validated by GPS acquisition with a front-end receiver. As example, figure 1 and figure 2 presents acquisitions realised respectively in free space and in a forest. The power signal in forest in lower than in free space which influence the positioning integrity (figure 3 & 4).

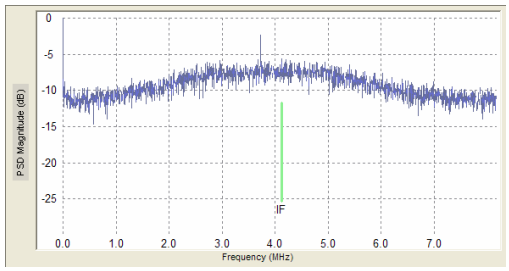

Fig. 1. DSP GPS signals in free space

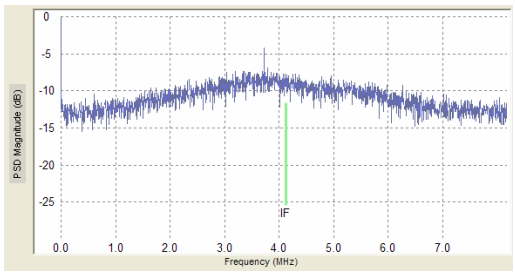

Fig. 2. DSP GPS signals in forest

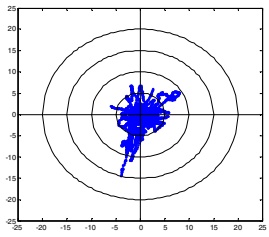

Fig. 3. GPS positioning in free space

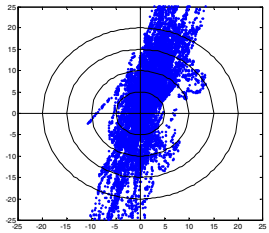

Fig. 3. GPS positioning in forest

III. MEMS POSITIONING

In order to compensate GPS limitation, we study an other positioning technique based on MEMS inertial measurements [6] which take into account LoCoSS project constraints. Sensors are positioned on firemen hip to characterize his walk (figure 5).

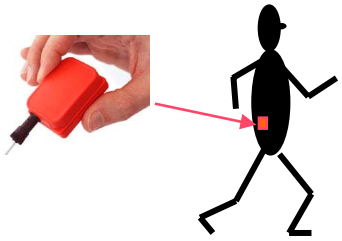

Fig. 5. MEMS sensors on firemen

Sensors are composed of three accelerometers, gyros and magnetometers. Accelerometers give the number and size of steps, the direction is provided by gyros and magnetometers. Then a relative positioning is obtained from the initial position. The main difficulty of this localisation is that the localization derives due to sensors errors. So, the longer the way is, the more the drift will be important.

IV. GPS AND MEMS FUSION

MEMS positioning is an alternative localization when GPS localisation is not just. But MEMS localization derives which is disturbing for firemen positioning. So we interest in GPS and MEMS fusion. MEMS will give a positioning when GPS informations are not usable. This positioning will be readjusted as soon as GPS positioning become again just.
For indoor application, use GPS positioning is not possible. So MEMS positioning is readjust from map-matching algorithm based on the building structure.

V. CONCLUSION

In this paper, we present some limitation of the GPS localisation in particular environments (forest, urban, indoor). We propose an other localization technique based on MEMS sensors. This technique presents also some limitations, but is operational when GPS is not. So we interest in GPS and MEMS fusion to obtain a high positioning integrity independently of the environment.

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