ERSEC

Enhanced Road Safety by integrating Egnos-Galileo data with on-board Control system

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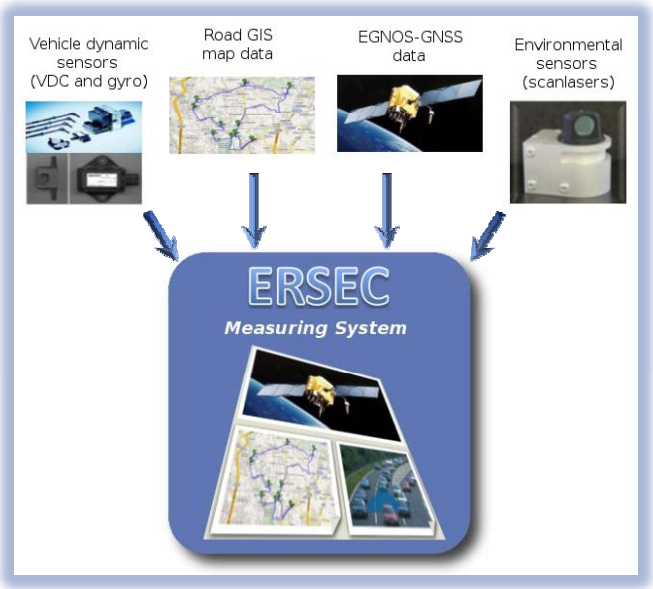


ERSEC intends to contribute a further step towards the goal to make vehicles safer

Consortium

Coordinator:
Eicas Automazione S.p.A.

Partners:
M3 Systems Sarl
S.C. Optoelectronica 2001 S.A.
Istituto Superiore Mario Boella

Project overview

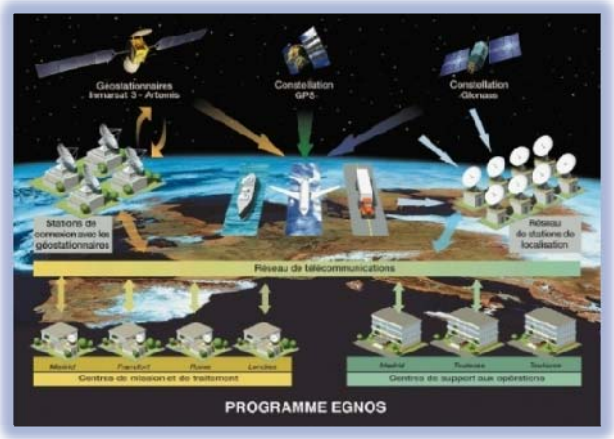
The general objective of the ERSEC project is concerned with the broadening of the scope of application to road transport of the EGNOS/GNSS (and later Galileo) through an appropriate integration and data fusion with measurement data coming from other measuring instruments.

The challenging **ERSEC S&T objective** consists in **achieving a significant improvement in the vehicle positioning accuracy, going from metres** offered by the EGNOS/GNSS **to decimetres** with an updating frequency of **100 Hz**, to be primarily applied for **significant enhancing performance and level of confidence of collision avoidance systems.**

The proposed approach is based on an **intelligent datafusion** of the **EGNOS/GNSS sensor** positioning measurement, the **Road-GIS digital local map** data and the measurement data obtained from an instrument set installed on board of the vehicle, including **vehicle dynamic sensors** (tachometer and gyro) and **environmental sensors** (scanlasers). Beside the hybridization with other sensors, the optimal use of EGNOS (and Galileo in the future) key differentiators (accuracy, integrity) will be a key factor for the success of the project and the application. This challenging target is required to open the possibility to apply the above positioning data to improve the performance of **active road safety systems** aimed to avoid collision and off road accidents.

Background and motivation

Nowadays road safety is a major concern and social issue. Although things have gradually improved in recent years, the number of road fatalities is still too high in the European Union. In 2007, road accidents killed over 40,000 people and injured more than 1.2 million. On 12 September 2001 the European Commission issued a White Paper on European transport policy setting an agenda for the European transport policy throughout 2010. Essentially, the programme sets out, with the requisite level of detail, specific measures (European Road Safety Action programme) in accordance with what the Commission has already endorsed, and reaffirms the overall ambitious target of halving the number of road accident victims by 2010. This objective constitutes a serious collective undertaking to reduce the number of deaths rather than a legal requirement.

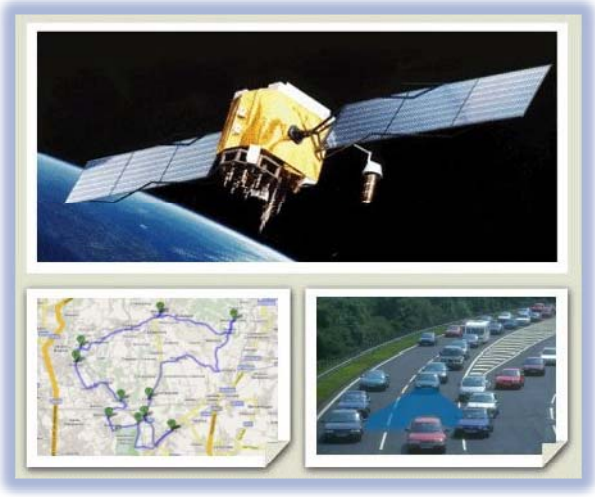


Many solutions exist for improving the safety on transport, many of them are already proven and available on the market, others are under development, others are still in phase of study and research. Such solutions span from ADAS (Advanced Driver Assistance Systems) to collision mitigation and avoidance systems. The reason for which EGNOS/GNSS system is not yet applied in road active safety can be found in the fact that the accuracy nowadays offered by such a system is in the order of metres. Such an accuracy not sufficient for recognizing the danger of out-of-road and/or establishing which is the better direction for deviating the vehicle trajectory in order to avoid the collision, without moving out-of-road.

ERSEC intends to **contribute a further step towards the goal to make vehicles safer**. The motivation of the research starts from the availability of EICASDRIVE, a Collision Avoidance System developed by EICAS along about ten years of research activity, that automatically deviates the vehicle trajectory in the last fraction of second before the impending crash, when the driver is no more able to intervene. A prototype of EICASDRIVE on an experimental car is at present under development as a part of MECCANO Italian research project- aiming at developing a "*new concept car*".

The ERSEC measuring system

The main project outcome is the ERSEC measuring system- to be used on board of vehicles –able to output the position on the road map of the equipped vehicle and of all the obstacles (such as other vehicles, peoples and any kind of fixed or mobile objects) around it with a **measurement accuracy of the order of 0.1 metre at a sampling rate of 100 Hz** through an **intelligent datafusion** of the **EGNOS/GNSS data** - correlated to the **Road-GIS digital local map** - with the measurement data obtained from an instrument set installed on board of the vehicle, including **vehicle dynamic sensors** (tachometer and gyro) and **environmental sensors** (scanlasers).



S&T methodological approach

The methodology proposed to achieve the ERSEC objectives is based on **an intelligent fusion of different state-of-the-art sensing technologies**, mainly:

- EGNOS/GNSS receiver for automotive application that outputs the position of the equipped vehicle on the road map (position measurement error: some metres, sampling rate: some Hz).
- road digital map and GIS
- the vehicle crash prediction system (developed and tested in previous research activities) based on scanlasers, tachometer and gyro - that outputs the position in the equipped vehicle reference frame of the obstacles detected around the vehicle at the sampling rate of 40 Hz. The obstacles position is continuously predicted in a distance < 10 m from the vehicle, within the horizon of 0.5 s and with the accuracy of 0.1 m.

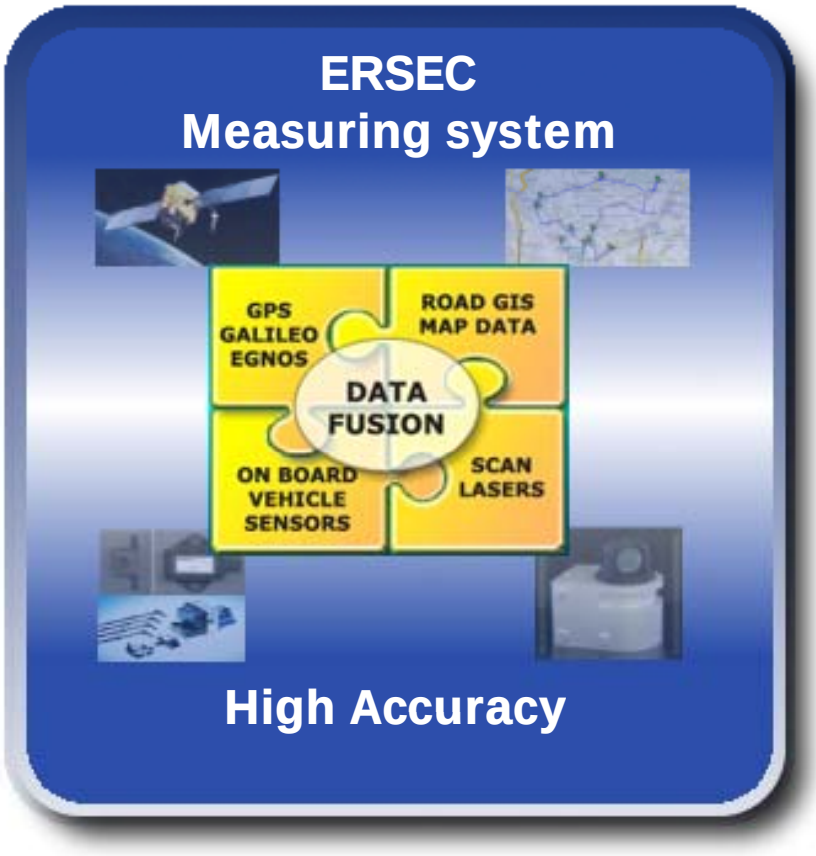
The ERSEC intelligent data fusion aims at achieving the positions of the equipped vehicle and of all the obstacles around it on the road map with the measurement accuracy of 0.1 metre at the sampling frequency of 100 Hz.

The significant improvement in vehicle positioning accuracy - going from metres offered by the EGNOS-GNSS to decimetres @ 100 Hz - is an effect of the possibility of identifying fixed objects detected by the vehicle scanlaser with those indicated in the road map so to use them as **reference markers** for the measuring system and of the application of sophisticated mathematical fundamentals based on the use of **dynamic filters** .

The core of the approach consists in replicating the same reasoning like a driver who could **compare the following two images**:

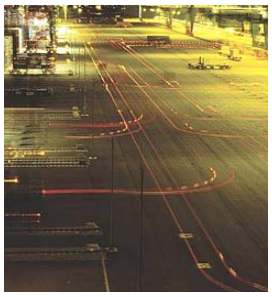
- the **map of the road** in which there are the indications of the vehicle position and of the various obstacles around it detectable by the scanlasers *(obtained through the EGNOS-GNSS data and the Road-GIS digital local map)*
- the **map of the obstacles** effectively detected by the scanlasers around the vehicle *(obtained through the scanlaser data)*.

The basic idea consists in **overlapping the two maps**, adjusting the position of the vehicle derived from the EGNOS-GNSS data.



Field of Applications and Impact

The ERSEC measuring system is at first applicable in **active road safety** to enhance performance and level of confidence of collision avoidance systems. In fact, the knowledge of vehicle and obstacle position and rate in the road map reference frame will enhance the reliability of the active control system intervention by helping to select a safer vehicle trajectory by referring to the local road geometry. Moreover, the precise vehicle positioning in the road reference system will extend the safety intervention of the active control system for reducing the vehicle speed in proximity of a curve, in the event the speed appears too high and recognizing the danger of out-of-road for warning in time the driver and/or automatically intervene. Last, but not least, expected improvement is related to the Collision Avoidance System fault tolerance.



At the same time the ERSEC measuring system represents a remarkable innovation in the sector of **Automated Guided Vehicles** (AGVs) because it opens the possibility of application of the AGVs also in constrained areas (industrial sites, airports, touristic or hospital centres), where nowadays the required infrastructures to implement the automatic vehicles guidance (rails, buried wires, magnetic beacons) are limiting the system functionality and flexibility and thus the development of this kind of transport system.

Partners roles

EICAS Automazione S.p.A. (excellence and passion in automatic control design)

Coordinator (Italy). Data fusion Algorithms for Collision Avoidance (concept and sw development). System modelling, simulation and rapid control prototyping techniques based on EICASLAB technology. Techniques of Fault Detection Isolation and Recovery.

m3 SYSTEMS

Partner (France). GNSS Signal Processing, EGNOS performance and integrity, EGNOS navigator prototyping

optoelectronica

Partner (Romania). Optoelectronics design, rapid prototyping, testing, manufacturing involved in open laser scanner design

ISMB Istituto Superiore Mario Boella

Partner (Italy). GPS and Galileo terminals, EGNOS and EDAS (EGNOS Data Access System) integration on embedded systems, Road GIS map data strategies.

For any further information please contact the project leader Dr. Gabriella Caporaletti (gabry@eicas.it)