

# POLARIS

*A Navigation System Performance-Analysis Software Tool*

# Galileo

*The European Programme for  
Global Navigation Services*



**A powerful navigation performance simulation tool to help shape the ultimate form of Galileo, POLARIS will clearly demonstrate the benefits provided by Galileo and complementary systems.**

## ✦ What is POLARIS?

POLARIS is a pilot project under the Growth thematic programme of the 5th Research Framework Programme of the European Union. Together with the Galilei study, it forms part of on-going research work for the Galileo programme. It is managed by the EU Directorate General for Energy and Transport.

POLARIS will allow the assessment of navigation performance using Galileo alone or combined with various GNSS systems and a wide variety of systems and sensors. A powerful simulation tool for users with a range of satellite navigation experience and needs, POLARIS will provide clear results that can be translated into Galileo system requirements.

## ✦ Objectives

POLARIS' is a powerful tool able to construct realistic simulations of Galileo-based navigation systems to support application and system design and to promote the use of Galileo. It will be easy to use and navigate but with enough flexibility to meet the customising needs of advanced users.

POLARIS will be able to model the four application domains that are most critical for mass-market application demonstrations: road, personal mobility, train and maritime. It will also provide a means for exploring new ideas for GNSS applications and demonstrating design feasibility to Galileo system designers.

## ✦ Applications

POLARIS will be able to model the four application domains that are most critical for mass-market applications: road, personal mobility, rail and maritime. It will also provide a means for exploring new ideas for

GNSS applications and demonstrating design feasibility to Galileo system designers.

For system designers, POLARIS will provide a tool that is easy to use, but flexible enough to satisfy their need for full control over the structure and content of simulations. Advanced users can access detailed simulation and model parameters that will enable the creation of highly customised simulations. System designers will also have a range of options for visualising and performing comparisons of the results obtained through POLARIS.

Market analysts and service providers need a tool that can be operated easily and efficiently to create demonstrations of Galileo-based systems. POLARIS will provide a tool that is intuitive and easy to manage. Simulations will be easy to compose through the graphical user interface, producing results that are suited to the demonstration purposes required by these users. Simple but representative versions of the models will provide an order of magnitude estimate that is also coherent with demonstration purposes. The requirements of these users can be easily met by running POLARIS on low-cost platforms without time- and resource-consuming simulation runs. POLARIS will also provide a function for comparing and visualising results that will assist market analysts and service providers in making the best choices for their customers.

## ✦ Technical information

POLARIS will balance the level of modelling detail with computational efficiency in order to provide a tool that can be used for quick and accurate navigation performance assessment. Careful attention is being paid to:

- integration of the observables coming from all contributing systems and sensors

**Galileo**



- modelling of the navigation systems, sensors and environment (obstacles, signal interference, multipath, etc.)
- optimisation of the complex mathematical operations
- efficiency of the navigation performance computation algorithms.

Following these principles, POLARIS will use two different approaches to compute navigation performances for a user-defined simulation:

- the evaluation of the observation covariance matrix, based on the User Equivalent Range Error, and the computation of the Dilution of Precision and Accuracy matrices for static users (e.g. over coverage areas) using least-squares
- additional filters for the assessment of navigation performances of dynamic users over a user-defined trajectory, including performance-aiding measurements from relative positioning sensors (e.g. odometer and magnetic compass).

The dynamic user simulation will allow a POLARIS user to analyse a hybrid navigation solution and clearly visualise the contributions that sensors make for various simulation configurations.

For Galileo, POLARIS will allow the assessment of the navigation performances at:

- system level. The intrinsic capabilities of the baseline Galileo constellation to determine accurately the location of a user receiver.
- user receiver level. The user receiver algorithms can filter different error sources during the satellite signal pre-processing.

In addition, POLARIS will be able to analyse Galileo combined with navigation-aiding systems that can improve performance from the point of view of:

- service availability and continuity. Using pseudolites, relative positioning sensors, etc.
- service quality. Using Galileo local elements, satellite-based augmentation system, etc.

**\* Schedule**

POLARIS began in January 2002 and will run for 24 months. It has completed an Architectural Design Review and delivered a prototype. POLARIS Version 1 will be delivered in July 2003, with supporting documentation. POLARIS Version 2 will be the last delivery, in October 2003. The project will culminate with the Final Review and delivery of final documentation in January 2004.

**\* Consortium**

POLARIS is led by:

- GMV, S.A.: a software company with extensive experience in satellite navigation and timing services.

The consortium includes:

- Galileo Industries: a space systems developer deeply involved in the Galileo system design.
- TeleAtlas: a company that develops geographical information databases.
- GMV Sistemas: a company with extensive experience in GNSS applications.
- The University of Nottingham/NSL: a UK university institute widely recognised for its expertise in GNSS application modelling.
- Edisoft: a company with extensive experience in software development.

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**How is Galileo different from other systems?**

- ✓ Galileo is specifically designed for civil and commercial purposes
- ✓ increased accuracy, service guarantees and certification
- ✓ traceability of past performance and operation transparency
- ✓ increased availability of signals in demanding environments

Galileo: The European Satellite Navigation Programme is a joint initiative of the European Commission and the European Space Agency. Galileo will offer positioning and timing services worldwide.



For additional information, please contact the Galileo Joint Undertaking: JU@galileo-pgm.org or visit the websites [http://www.europa.eu.int/comm/dgs/energy\\_transport/galileo/](http://www.europa.eu.int/comm/dgs/energy_transport/galileo/) <http://www.esa.int/navigation/galileo/>