



R-Mode Baltic

Safe Navigation in the Baltic Sea



EUROPEAN
REGIONAL
DEVELOPMENT
FUND

CHALLENGE

Signals from Global Navigation Satellite Systems (GNSS) are the primary sources for Positioning, Navigation and Timing (PNT) information on-board a vessel today. These signals are prone to interferences. A backup system is needed to provide more robust PNT data in areas with risk of collisions, e.g. coastal areas and harbour entrances.

GOAL

R(anging)-Mode is a technology that utilises existing maritime radio beacons or Automatic Identification System (AIS) base stations by adding ranging components to the legacy signals. Until 2020 the R-Mode Baltic project team will establish the world's first R-Mode testbed in the Baltic Sea, utilising both station types, and will develop first user applications demonstrating that R-Mode is able to meet maritime user requirements for a backup system.

APPROACH

The project team will develop robust methods for the implementation of ranging signals – without interfering with the functions of legacy receivers – and a concept for GNSS-independent accurate station timing. Furthermore, system and user hardware will be developed as well as two applications. R-Mode will be added to the maritime infrastructure of Sweden, Poland and Germany. Project standardisation activities will enable other administrations to upgrade their infrastructure.





R-MODE-ENABLED MARITIME RADIO BEACON

Radio beacons provide differential corrections for GNSS by low data rate transmission in the medium-frequency radio band around 300 kHz. Based on already available R-Mode developments using continuous wave and the legacy signal, the project team will investigate methods to solve the signal wave ambiguity error by advanced signal design and signal processing. Furthermore, methods will be developed to mitigate the impact of skywave-induced fading. Up to six radio beacons will be upgraded to fully support the R-Mode technology.



R-MODE-ENABLED AIS BASE STATION

AIS base stations provide information from shore using AIS messages transmitted in the very high frequency (VHF) radio band around 162 MHz. The project team will test implementation of R-Mode on AIS and VHF Data Exchange System (VDES) signals. An optimal signal design will be selected and algorithms for range estimation will be developed. The data channel load will be considered. AIS base station equipment of four stations will be adjusted for the transmission of R-Mode signals.

TIME SYNCHRONISATION OF R-MODE TRANSMITTER

R-Mode transmitters must operate with a mutual time accuracy of a few 10ns. The project will analyse the performance of currently available time comparison methods and station clock alternatives, and will suggest a suitable R-Mode timing infrastructure. Furthermore, self-synchronisation of R-Mode will be studied. A proof-of-concept of a transnational cost-efficient time synchronisation solution with suitable hold over clocks at the transmitter sites will be developed and demonstrated.



R-MODE-POSITIONING

Based on existing GNSS receiver platforms, hardware for two prototype receivers and processors with different levels of integration will be developed. The software included will meet the R-Mode requirements and will include the project research results on R-Mode positioning methods. At the end of the project, the prototypes will be tested extensively to demonstrate the capability of the R-Mode technology.



R-MODE APPLICATIONS

An existing prototype of a PNT Data Processing unit will be upgraded to support R-Mode receiver raw data input. This approach facilitates the position calculation based on R-Mode signals transmitted by maritime radio beacons and/or AIS base stations. In the case of loss of GNSS positioning, it will automatically provide an R-Mode based position. A portable pilot unit (PPU) will be equipped with an R-Mode module. With GNSS available, the unit works in its standard operation mode. Once GNSS positioning fails, it will automatically switch to R-Mode operational mode. The R-Mode PPU will provide information regarding the active positioning mode to the pilot via its display.



THE LONG ROAD TO R-MODE STANDARDISATION

Maritime radio beacons and AIS base stations are designed to meet international standards, recommendations and guidelines of IALA, IMO, ITU, IEC and others. Therefore, the implementation of R-Mode technology on these stations requires the change or at least amendment of existing international standards. The project team will forward to, communicate with and encourage various standardisation committees and international organisations to improve and broaden the scope of existing PNT standardisation by the implementation of the R-Mode technology.

PARTNERS



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