Predictive maintenance.
Results from SIA EU-GNSS project

Session 7A: Innovative approaches to Asset Management

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Objectives

**MAIN GOAL**

To develop 4 ready-to-use new services to provide prognostic information about the health status of the railway’s most demanding assets in terms of maintenance costs, at the points of interaction between the vehicle and the infrastructure (wheelset, pantograph, rail & catenary)

**Common features:**
- Plug-in WW based on Web App
- Real-Time info about assets’ status
- Prognostic health status assessment
- Integration with operation systems
Objectives

- Development of low-cost sensor nodes (SIA_NoS) for wheel to rail and pantograph to catenary interaction characterization.
  - Sensors
  - Pre-processing Hardware
  - Wireless communications
  - Autonomous / Wired Power supply
- Development of data hub (SIA_DH) that collects on-board information, provides accurate position and time stamping with high availability, and transmits the information to a trackside visualization platform.
  - Galileo Initial Services multi-constellation / multi-frequency approach
  - EGNOS information
  - IMU
  - Finger printing algorithms
- Development of predictive component degradation models (SIA_CDM) that will enable to connect the monitoring information from wheelset, rail, catenary and pantograph with the asset management information system of end-users.
  - Physical models
  - Combination with monitored data
- Development of a visualization platform (SIA_VP) with two plug-in software modules specific for the railway infrastructure (track and catenary) and vehicle maintenance (wheelset and pantograph).
  - Cloud hosted
  - Big-Data visualization techniques
  - Prognostic health monitoring of the key assets
  - Real-Time early detection service of wheel flats and broken rails
Concept & Components

SIA constituents

**SIA_DH**
EGNSS-based positioning, and communications

**SIA_NoS**
Wheel to rail and catenary to pantograph interaction sensors

**SIA_CDMD**
Wheel, rail, pantograph and catenary degradation models

**SIA_VP**
Visualization platform customized for IMs and TOCs needs

IMs information system

iRailMon and iCatMon plug-in web based applications

TOC information system

iWheelMon and iPantMon plug-in web based application

On-board constituents

Track side cloud server constituents

SERVICE BACKBONE

SERVICE

END USER

iWheelMon and iPantMon plug-in web based application
**Concept & Components**

**SIA_VP**: Vehicle prognostic health monitoring visualization
Integration in already existing vehicle maintenance information system

**SIA_CDM**: Vehicle component degradation models

**SIA_DH**: Data Hub with localization and time stamping, and communications

**SIA_NoS**: Network of sensors to capture interaction between vehicle and infrastructure (wheel to rail and pantograph to catenary)

**SIA_VP**: Infrastructure prognostic health monitoring visualization
Integration in already existing infrastructure maintenance information system

**SIA_CDM**: Infrastructure component degradation models

**Top rail RCF KPI**: crack depth
- 10mm
- 7.5mm
- 5mm
- 2.5mm

**Situación de tramo**: “j” en línea “i”

**Equis**: Rail LWR
**Equis**: Rail TWR
**Equis**: Rail LWL
**Equis**: Rail TWL
**Equis**: Rail RCF Top
**Equis**: Rail RCF Bottom
**Equis**: Rail dips R
**Equis**: Rail dips L
**Equis**: Rail corrugation R
**Equis**: Rail corrugation L
**Equis**: Rail longC R
**Equis**: Rail longC L
**Equis**: Vertical alignment R
**Equis**: Vertical alignment L
**Equis**: Rail twist

**S&C**
- **wear** direct – blade
- **wear** diverted – blade
- **RCF** direct – blade
- **RCF** diverted – blade
- **wear** – nose
- **RCF** – nose
- **plastic deformation** – nose

**Pad**
- **fatigue**

**Clamp**
- **fatigue**

**Sleeper**
- **fatigue**

**Amolado**
- **Renovación rail**
- **Inspección**

**P6_Config**

**HERMES**
Menu

**+4σ**
**-4σ**
**+6σ**
**-6σ**
**+2σ**
**-2σ**

www.railway-asset-management.org
Concept. Visualization example
Methodology

- 4 pilot projects in 2 validation scenarios
- Integration of information within end-users’ information systems
- Validation of degradation models
  - 5 years of historic records (from validation scenarios)
  - Years 1-2 for model calibration
  - Years 3-4 for predictions assessment
  - Year 5 for operative validation
- Maintenance cost reduction validation
  - Historical cost records
  - Potential reduction with the new services
- Business plan validation
  - INNOTRANS 2020
  - 20 potential customers during pilots
Ambition

- Progress beyond the State-of-the-Art
  - **Prognostic health monitoring** of key railway assets
  - Low-cost Real-Time monitoring system
  - Energy harvesting capabilities
- **EGNSS localization techniques**
  - Low-cost positioning solution that provides high accuracy and high availability in the railway environment
  - Finger printing using vehicle dynamics gathered data
  - Positioning algorithm testing tool
- **Component degradation models**
  - Degradation models: combination of physical modelling & sensors’ data
  - Predictive algorithms
- **SIA innovation**
  - New end-to-end EGNSS based services to address end-user needs
  - Combination of cutting-edge technologies to provide added value to end users
  - Innovation in business model
Impact statement

- Maximize the potential of the EGNSS and its adoption in transport
- Demonstrate the benefits of the use of Galileo and EGNOS in rail transport
- More modern, efficient and user friendly rail transport system
  - 25% reduction of unscheduled maintenance activities
  - 15% reduction of maintenance cost
  - 15% reduction of derailment-risk
- Coordination of multiple actors and other pilot projects
  - Presence in Shift2Rail and participation in other H2020 projects
  - UIC leading dissemination activities
  - Advisory Group
- Encourage market take-up of the developments
  - TRL8 developments
  - Business plan
  - Consortium as a whole
Consortium

Railway best practices and standards promoters

Technology providers

EGNSS-based solution provider
IT services provider and SW solutions
Infrastructure and train operating companies
Railway maintenance services

Potential end users

DLR
ceit
NSL
uic
VIA
telice
FGC
OBB

European Global Navigation Satellite Systems Agency

SIA

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Thank you for your attention!

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