NAVWAT - Future High Precision Navigation System for Inland Waterways

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NAVWAT

- **Concept Study** investigating new applications for future GNSS systems
- Funded by the Federal Ministry for Transport, Innovation and Technology through the Austrian Space Application Programme, 6th Call

Partners: via donau (lead), TeleConsult Austria

Project Duration: April 2009 – March 2010
Project Goal

- Identify inland waterways applications that
  benefit from high accurate positioning services
  provide an operational benefit (safety and/or efficiency) to ship users

- Propose a technical solution

- Derive requirements for future GNSS systems
River Information Services

  - ... optimising the use of the infrastructure and
  - ... improving safety on European waterways.
RIS on the Danube
Current problems

- Collisions with infrastructure
Current problems

- Collisions with infrastructure have often severe secondary effects (example: railway bridge)
Current challenges

- Need to improve tracking & tracing technologies:
  - Shape of vessels not displayed accurately (especially for barge convoys)
  - Position information lacks accuracy & integrity
Application Scenarios

- Three scenarios that require high accurate GNSS position information
- They represent the situations with high risk of collisions with infrastructure
  - Approach to river lock
  - Passing a bridge
  - Approach to riverside berths and ports
Scenario 1

Approach to Lock

- Difficult maneuver with only limited space available
- Effects of currents and wind
Scenario 2

Passing a bridge

- Narrow corridor to pass at full speed
- Vessel needs to be aligned well in advance
Scenario 3

Approach to berth
- Accurate guidance required
- Effects of currents and wind
User Community interviews

- Early involvement of user community is important
- Have been considered in system design
- User feedback
  - Position information should be reliable
  - Modeling of convoy shape shall require minimum interaction
  - Try to avoid fixed installations on barges (reasons of theft)
  - Integration with existing Hardware/Software onboard
  - Different requirements for convoys and motorised cargo vessels
Identified Challenges

- Modeling of convoy shape
- System architectures that meet the specific needs
- User Terminal Design
System Design Highlights

• Three System Architectures
  • SA 1: Large convoys
  • SA 2: Small-medium convoys
  • SA 3: Individual vessels

• Innovative concept for convoy shape determination

• Integration of Inland ENCs containing information on river infrastructure

• Integration into RIS Concept through
  • Provision of accurate position and heading information (improved Tactical Traffic Information)
  • Automatic update of convoy size in Inland AIS transponder
Modeling of convoy shape

Operational constraints
- Cargo transport is often done by barge convoys
- Modeling of convoy shape is complex
- Users comment: Automated approach required
Modeling of convoy shape

• Definition of reference points at characteristic corners

• Semi-automated definition of a mathematical shape represented by the reference points
User Terminal Design

Barge units:
- Removable
- Robust
- Waterproof
- Battery backup

Vessel
- GNSS antenna 1
- GNSS antenna 2
- GNSS reference and heading receiver
- Power supply
- NAVWAT Processing Module
- Communication module
- Inland AIS Transponder
- Inland ECDIS

Barge 1
- GNSS receiver
- Power supply
- Comm. module

Barge 2
- GNSS receiver
- Power supply
- Comm. module
Specific challenges for GNSS in the inland waterway environment

- Signal shading by topography and infrastructures
- Frequent signal blocking when passing under bridges
- Limited reception of augmentation signals from GEO satellites
- High multipath effects in the vicinity of infrastructures
Requirements for future GNSS

GNSS Systems analyzed

• GPS including the GPS modernization process
• GLONASS including the GLONASS modernization process
• Galileo including not only L-band but also potential C- and S-band signal extensions
• Other GNSS systems like the future Chinese COMPASS
• SBAS systems including future evolutions like WARTK
• Conventional DGNSS systems including RTK
• Virtual Reference Station DGNSS
• Precise Point Positioning technologies
Requirements for future GNSS

Candidate Systems

- **GNSS**
  - GNSS system of systems (GPS, Galileo, etc.)

- **Augmentation**
  - Future SBAS with WARTK
  - Virtual Reference Station Network solution
Feasibility of pilot implementation using current GNSS infrastructure

- Implementation feasible using conventional RTK system
- Key innovative parts can be demonstrated
  - Convoy shape modeling
  - Protection level computation (Integrity information)
  - Integration into RIS architecture (Inland AIS, Inland ECDIS)
- Demonstration to users would enhance the desired user acceptance – accelerated product roll-out when the necessary GNSS infrastructure is available
- Product introduction could immediately start when new GNSS services are available
NAVWAT 2 is …

- **Pilot implementation** of the NAVWAT Concept.
- Funded by the Federal Ministry for Transport, Innovation and Technology through the Austrian Space Application Programme, 7th Call

- Partners: TeleConsult Austria (lead), via donau
- Project Duration: Jan. 2011 – June 2012
NAVWAT 2

Status:
• System design and development ongoing
• Pilot system to be tested in a real-life environment on Austrian Danube in spring 2012
Related Activities

• **ARIADNA** - Maritime Assisted Volumetric Navigation System
  • Development of **innovative navigation solutions** for management of vessel traffic to avoid human error in navigation and to **improve efficiency and safety**.
  • Focus:
    • Collision avoidance vessel-to-vessel and vessel-to-infrastructure
    • Representation of vessel shape and risk area (ship volume)

• Programme: FP7, THEME 7: Transport (including Aeronautics)
Related Activities

- Relative movements based on position information
- Relative movements based on georeferenced volume information
- Improvement of safety and efficiency due to better risk modeling

Logos: NavWat, Ariadna, Viadonau, TeleConsult, ASAP
Conclusion

- Collision avoidance is a topic still to be exploited
- NAVWAT identified three applications scenarios
- Highly accurate positioning information is a prerequisite
- Operational constraints & needs have been accounted for
  - Modeling of convoy shape
  - Mounting restrictions on barges
  - Integration into RIS architecture is a must
- Future GNSS and augmentation system requirements have been identified
- Pilot implementation with current GNSS infrastructure will be realized in the follow-up project NAVWAT 2
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