Full Implementation of the River Information Services of Border and Lower Section of the Odra in Poland

Conference Paper · June 2016

DOI: 10.1109/BGC.Geomatics.2016.33

CITATIONS
5

READS
46

1 author:

Andrzej Stateczny
Gdansk University of Technology
99 PUBLICATIONS **1,211** CITATIONS

SEE PROFILE

Full Implementation of the River Information Services of Border and Lower Section of the Odra in Poland

Andrzej Stateczny
Marine Technology Ltd.
Szczecin, Poland
a.stateczny@marinetechnology.pl

***Abstract*—During 2015 year functional-utility program of full implementation of River Information Services (RIS) of border and lower section of the Odra in Poland was developed by consortium of Marine Technology Ltd. and Lemtech Consulting Ltd. The technical part of functional-utility program, made by Marine Technology Ltd., presents the concept of the construction of the system allowing for the achievement of assumptions resulting from analytical works, including the results of the pilot implementation, the expectations of the Inland Water Authority and own analyses and experiences. In the article the aim and the assumptions of the Odra RIS implementation, the location and spatial scope, legal and formal conditions, hardware and software functionality and infrastructure connected with the acquisition and transmission of data and the provision of services are presented.**

Index Terms— information services, sensors, navigation.

I. INTRODUCTION

RIS (River Information Services) is a set of harmonized information services for the purpose of traffic and transport management in inland navigation, realized via one or more harmonized IT systems. The main purpose of introducing RIS is to make inland navigation a clear, effective, flexible and easily accessed means of transportation, able to compete with other ways of transporting cargo. Another important aspect is to improve the safety of inland navigation.

The pilot implementation of the RIS system for the lower part of the Odra was completed in 2013. It was the first River Information Services implementation in Poland. During implementation process of pilot stage in 2013 all so-called key RIS technologies were introduced. Were produce and make available inland electronic navigational charts (Inland ENC), provide notices to skippers services (NtS), make available hydrometeorological information and monitor navigation situation on fairways mainly carried out by AIS, DGPS and VHF technologies and supported by surveillance cameras and radars. Marine Technology produced in this stage first Inland ENC in Poland.

The RIS river information system for Lower Odra implemented during pilot stage was covered the waterways of the lower Odra river from the town of Ognica to Szczecin. This stretch of water has been classified as Vb waterways. Total length of the waterways is 97.6 km. According to legal requirements, the RIS covered the areas of the following inland waterways:

- lake Dąbie up to the internal sea water boundary – 9.5 km;
- river Odra from the town of Ognica to the Klucz-Ustowo cross-cut and farther, as river Regalica, all the way to where it flows into lake Dąbie – 44.6 km;
- the West Odra river, from the weir at Widuchowa to the internal sea water boundary, along with its lateral branches – 33.6 km;
- the Klucz-Ustowo cross-cut connecting East Odra and West Odra – 2.7 km;
- river Parnica and the Parnicki cross-cut from the West Odra to the internal sea water boundary – 6.9 km.

It was assumed during pilot stage that the system should incorporate the possibility to increase its effective range, covering at least the additional stretch of Odra between Ognica and Hochensaaten.

The pilot introduction of the RIS system implemented key RIS technologies to a sufficient extent. The following services were provided:

- Fairway information services are realized mainly through:
  - electronic navigational charts for the entire RIS area;
  - ship operator messaging service under NtS;
  - supplying hydrometeorological information under NtS, within the AIS system and via an internet website;

978-1-5090-2421-6/16/$31.00 ©2016 IEEE

  - supplying information on water levels under NtS, within the AIS system and via an internet website;
- Traffic information – realized mainly through:
  - transmission of DGPS adjustments using AIS in order to pinpoint the positioning of the vessels;
  - preparation and presentation of the Strategic Traffic Image based on AIS data;
  - preparation and presentation of the Tactical Traffic Image based on the data collected from radar sensor arrays, cameras, as well as AIS and VHF – due to the sensor reduction, a partial transferring of TTI acquisition tasks to the final implementation stages was assumed;
  - implementation of vessel tracking and tracing technology;
  - implementation of electronic reporting technology.
- Traffic Management – realized to a limited extent, mostly through:
  - large scale presentation of vessel positions.

It was assumed that – within the pilot project – other RIS system services will be supported by providing an open system and data transmission capabilities in the form of network and XML services for interested and authorized users. To accomplish that goal, the International Data Exchange system will be implemented, according to specifications set under previous European projects (due to the lack of formal standards).

II. .Full Implementation of Border and Lower Section of Odra

The pilot implementation of the RIS system for the lower section of the Odra focused on fairway information services (FIS) and traffic information services (TIS). Planned extension make system longer along the whole border section of Odra river. Some problems of RIS sensors implementation and multisensory data fusion were described in [1-11].

Marine Technology Ltd. developed in 2015 technical part of functional-utility program of full implementation of River Information Services (RIS) of border and lower section of the Odra in Poland.

Pilot implementation was limited to the waters in which its introduction was mandatory. In practice, it means not quite 100km of waterway in the area of the lower section of the Odra [12].

As a result of the analysis of the influence of fulfilment of possible area variants, so-called optimum variant being a compromise between the increase of the territorial scope of the full implementation of RIS and the optimization of the costs of the project in relation to the achieved benefits in the form of launched services was chosen. This variant assumes the increase of the RIS area by 117km upriver up to the motorway bridge in Świecko. All in all the area of the full implementation of RIS (together with the area already included in the pilot implementation) covers the following basins [12]:

- Dąbie lake up to the border with internal sea waters – 9.5 km;
- the Odra river from the motorway bridge in Świecko up to the Ditch Klucz-Ustowo and further as the Regalica River up to the mouth of Dąbie lake – 161.6 km;
- the Western Odra river from the weir in Widuchowa up to the border with internal sea waters together with lateral branches – 33.6 km;
- the Ditch Klucz-Ustowo which connects the Eastern Odra river with the Western Odra river – 2.7 km;
- the Parnica river and the Parnicki Ditch from the Western Odra river up to the border with internal sea waters – 6.9 km
- the section of the Warta river from the Water Supervision in Świerkocin up to the mouth of the Warta river – 28.5 km.

The total length of waterways is 242.9 km. In the adopted concept contact points of inland waters with sea waters in Szczecin (Trasa Zamkowa (the castle route), the bridge on the Parnica river and the mouth of the Babina river to the Odra river) are the border points of RIS in the north and the motorway bridge in Świecko is the border point of RIS in the south. It is worth emphasizing that apart from the Odra river itself, key junctions of waterways will also be monitored by placing sensors on the Warta river (Świerkocin and Kostrzyn nad Odrą) and by using sensors placed on the German side in the region of the Hochensaaten lock.

When writing about the location of RIS, three main points of the software infrastructure in which RIS services will be provided should also be indicated. These are the RIS Center in Szczecin, the RIS SubCenter in Kostrzyn nad Odrą and the Emergency Server Room in Szczecin. The analyses of functional needs indicated the necessity for construction of a new RIS Center (and at the same time the seat of the Inland Navigation Office in Szczecin). It will be situated in Szczecin in the plot of land at the junction of the following streets: Zbożowa and Energetyków. It is proposed to locate the RIS SubCenter in Kostrzyn nad Odrą in Lubuskie Province in the existing building which is located at ul. Graniczna 4. The role of the emergency server room will be taken by the existing main server room built as a part of the pilot implementation in the building of Czerwony Ratusz in Szczecin at pl. S. Batorego 4 [12].

The full implementation of RIS of border and lower section of the Odra river is designed to implement technologies checked in the pilot implementation and to develop them in the area and functional aspect in order to ensure the desired level of RIS at the selected section of the border and lower Odra

978-1-5090-2421-6/16/$31.00 ©2016 IEEE

river. The presented concept assumes the provision of the following services:

- fairway information services (FIS) – mainly provided by means of:
  - electronic navigational charts
  - notices to skippers,
  - provision of hydrometeorological information, including in particular ice information and water status,
- traffic information services – mainly provided by means of:
  - development and presentation of the Strategic Traffic Information (STI) and the provision of such information to authorised users,
  - development and presentation of the Tactical Traffic Information (TTI) and the provision of such information to authorised users,
  - implementation of vessel tracking and tracing technologies,
  - transmission of DGPS corrections,
  - allowing the use of VHF communications subsystem for authorised users,
  - ensuring technological readiness to start the electronic ship reporting (ERI) and electronic international data exchange (IDE),
- calamity abatement support services – mainly provided by means of:
  - provision of and access to information on incidents based on VTT services and VHF communications services,
  - situation assessment in shipping traffic in connection with the occurrence of an incident based on VTT services and VHF communications services,
  - support of icebreaking actions through the provisions of current information on waterways (including hydrometeorological information),
  - allowing the use of VHF communications subsystem by means of remote access applications for authorised users,
- statistics collection services (ST) – mainly provided by means of:
  - generation of statistics on the basis of archived data concerning the hydrometeorological situation and traffic conditions on fairways.

The provision of such services requires the implementation of all key and base technologies of RIS that have been used in the pilot implementation. The indication of the technology of video monitoring as a key monitoring in the scope of monitoring of conditions on fairways is the most significant change in the philosophy of the provision of services. Therefore, a significant development of the video monitoring network has been planned and the plan to further develop the radar network has been abandoned.

Main source for information presentation is system of electronic charts – Inland Water Electronic Navigation Charts system. Problem of data gathering, post-processing and chart production was discussed by many authors [13-23].

III. Functional Structure of RIS

The provision of the presented scope of RIS requires the construction of appropriate building, technical and ICT infrastructure. In the outline the proposed functional infrastructure includes four basic segments [12]:

- segment of sensors – sources of data,
- segment of data transmission – place of collecting and storing data,
- segment of operators – place of processing data and making services available,
- segment of RIS users – recipients of services and information.

The provision of the majority of RIS is based on the data acquired from the segment of sensors. This segment includes specialist equipment which receive (and sometimes also transmit) a specific kind of information and transfer it to the segment of data transmission. The development of networks existing after the pilot implementation (apart from h radar network) is offered as part of the full implementation. It is assumed that the full coverage of the RIS area with AIS and VHF systems will be ensured. Additionally, the video monitoring system will be significantly development and water level gauges, at the Employer's request, have been planned on which bridge in the RIS area.

Therefore, as part of the full implementation of RIS, the segment of sensors includes [12]:

- AIS base stations,
- DGPS reference stations,
- radars (only in the area of the pilot implementation),
- surveillance cameras,
- meteorological stations, also known as hydro-meteorological sensors,
- microwave water level gauges.

The segment of data transmission is responsible for the transfer of information from the segment of sensors.

The main transmission axis of the development network in the proposed concept includes 5 points which will be

978-1-5090-2421-6/16/$31.00 ©2016 IEEE

connected with the Internet network. These are the following locations:

- Widuchowa weir,
- Water Supervision of the Regional Water Management Authority in Gozdowice,
- RIS SubCenter in Kostrzyn nad Odrą,
- Water Supervision of the Regional Water Management Authority in Słubice,
- Water Supervision of the Regional Water Management Authority in Świerkocin.

In these locations signals from nearby sensors are gathered and, then, transmitted by means of the cable link to the RIS Center . It also assumes the possibility of giving local access to the signal from cameras in certain sensor stations.

The RIS concept is supplemented with the segment of users in which three main groups can be distinguished:

- basic users,
  - RIS operators,
  - vessel users,
- associated users (administration and services),
- other users.

RIS operators who deliver information to other users play a key role in the system. The groups of recipients differ due to the data and service access permissions held and due to the way of interaction with the RIS system.

The RIS system as a whole is a system of integrated and harmonized subsystems which can be treated as separate components. Very important part of system are segment of sensors and segment of data transmission.

IV. Design of Sensors Network

In the scope of the radar sensor network no assumption has been made because the project does not pride for any liquidation, extension or modernization of existing points of radar supervision installed at the pilot stage. However, a significant development has been provided for the monitoring system.

It is planned to install 16 new cameras. Camera points were established in the places in which sections of waterways have to be supervised based on a continuous video monitoring. The main task of the camera system is to deliver a high quality video images to the RIS Center in order to allow for the monitoring of both traffic and water surface conditions (e.g. ice conditions) on selected sections of fairways. Some aspects of camera image processing are described in [24-25].

The control of hydromoteorological conditions will be possible thanks to the network of weather stations and water level gauges. It is planned to installed 4 new weather stations and 23 water level gauges. Water level gauges in the new area of RIS have been planned on bridges which constitute the main navigational limitation (next to the water depth). It was assumed that water level gauges should be doubled in most locations to increase the level of availability of information.

The information on vessel in the area of RIS will be provided by means of the AIS system. In order to provide a full coverage of the RIS area with the signal, it was planned to construct 5 new locations of AIS. In each of them two base stations operating in the “hot-stand by” should be installed in order to ensure the reliability of the system.

The AIS network constitute the basis for the construction of the image of vessel traffic. The accuracy of the position of vessels will be ensured by the construction of the chain of DGPS stations. It is planned to install them next to AIS stations. Thanks to it, differential corrections will be sent to the receivers of the users of waterways with the use of AIS aerials. Such a configuration of the system performed well in the pilot implementation and the suggested solution is only the development of the existing system in order to provide a full

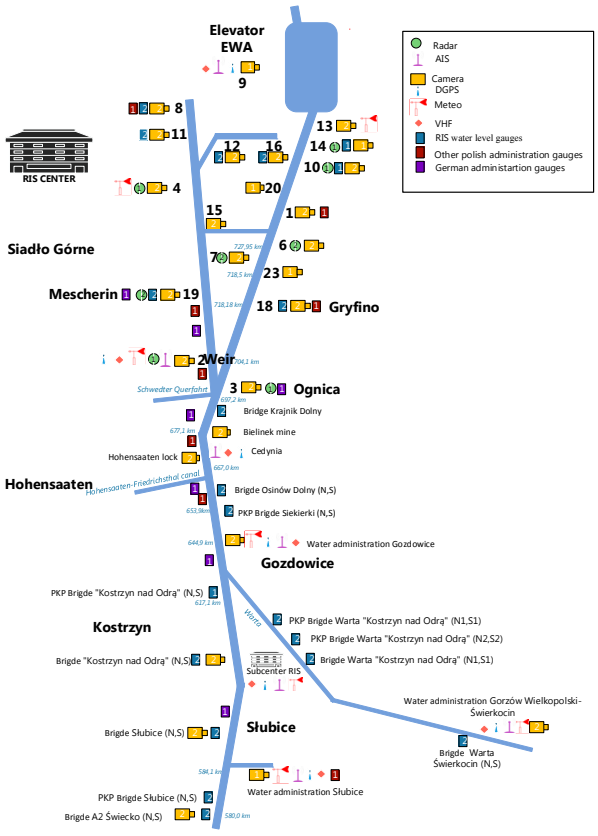

Fig.1. Schema of existing and planned RIS sensors.

978-1-5090-2421-6/16/$31.00 ©2016 IEEE

coverage of the RIS area with DGPS corrections.

Schema of planned sensors was worked out and is presented on are presented Fig. 1. Locations implemented during pilot stage are marked with numbers and new one with names.

V. Design of Data Transmission Network

The segment of data transmission is a component collecting information from particular sensor subsystems. Its task is to transfer data from sensors to the RIS Center. It is assumed that the existing data transmission network will remain, but unlicensed radiolines which do not meet the expectations and are longer than 1 km will be modernized. Additionally, in the places where it is possible and additional permanent connection to the Internet will be connected and the existing network node in the current server room of the RIS Center will be modernized and will become a network node in the emergency server room collecting data from the existing network of sensors. Data will be transmitted to the main server room which will be located in the new RIS Center by means of a new fiber optic connection (of minimum speed of 1Gb/s).

The data from the new part of the system will be transmitted via the Internet to the main server room. The way

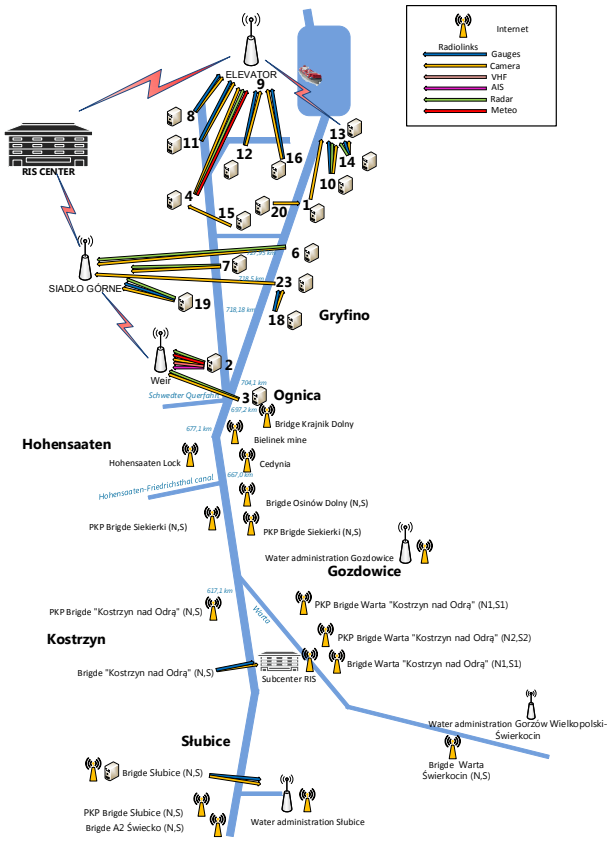

Fig.2. Data transmission network.

of connection to the Internet will depend on the type of data provided by particular sensors. The following items will be used:

- data transmission network of mobile operators (sufficient to transmit text data);
- unlicensed radiolines to the place in which permanent connection to the Internet can be obtained;
- direct connection (by means of an appropriate cable) to the existing broadband link to the Internet in a given location.

The selection of bandwidth will take connected sensors into consideration, but video data transmission will be definitely the most demanding for the network.

Schema of planned data transmission network is presented on Fig. 2. Locations implemented during pilot stage are marked with numbers and new one with names.

The VHF voice communications network is a separate element of the data transmission system. Radio communication is a basic means of communication between units and also in the relation ship-to-shore. All VHF base stations will be connected by using the data transmission network with the main server room. Operating applications located in the RIS Center and Subcenter will provide remote-controlled VHF base stations and they will make it possible to conduct monitoring and obtain answers from RIS operators. Voice communication will be also possible at the level of the application started from remote locations.

VI. Concept of Project Implementation

The project understood as the design of the full implementation of RIS of the border and lower sections of the Odra river should be implemented in several stages separated in terms of the Investor's ability to control the implementation of the project. At the first stage a contract engineer should be selected in the tender procedure who will supervise the entire investment for the Investor, especially in terms of diligence, quality and timeliness of implementation of particular stages of the investment. The contract engineer should also participate in the preparation of the tender documentation to select a comprehensive contractor of the RIS system. The concept of selecting only one contractor was assumed in the study who will be responsible for a comprehensive implementation of the entire system by combining construction and IT works. An appropriate selection of the contractor will be a key issue having an influence on the possibility of completing the investment on time and on the provision of the required functionality, therefore, the requirement relating to the system and the contractor were presented in detail in the Functional-Utility Program. The contractor should have experience in the scope of the implementation of the investment of this type in the European market.

978-1-5090-2421-6/16/$31.00 ©2016 IEEE

The implementation process can be divided into following stages:

- development of construction projects and obtaining relevant permissions;
- development of the project of the system;
- construction works;
- development of the detailed system specification;
- construction of software components;
- system implementation;
- tests;
- training;
- acceptance.

It should be emphasized that some tasks can be performed at the same time, which should relax the schedule of the project. Completely different works connected with the construction part and the IT part in the initial phase of the project can be carried out independently (but with mutual consideration of the assumptions) and they will be combined at the implementation stage of the project.

VII. CONCLUSIONS

The paper presents the results of river information services implementation on the RIS Lower Odra area during pilot faze and planned implementation during extension stage of Odra RIS.

During pilot stage the first RIS system was installed in Poland. There is the most sophisticated RIS sensors network in Europe.

The experience gained during Odra RIS planning and implementation could be useful for other RIS implementation in Poland especially along Wisla River.

References

[1] A. Stateczny, and J. Lubczonek, "Radar Sensors Implementation in River Information Services in Poland". Proceedings of 15th International Radar Symposium (IRS), K. Kulpa (Ed.), 199-203. Gdansk, 2014, DOI:10.1109/IRS.2014.6869248

[2] A. Stateczny, and J. Lubczonek, "FMCW Radar Implementation in River Information Services in Poland". Proceedings of 16th International Radar Symposium (IRS), International Radar Symposium Proceedings, H. Rohling (Ed.), pp. 852-857. Dresden, 2015, DOI:10.1109/IRS.2015.7226245

[3] J. Łubczonek "Analysis of accuracy of surveillance radar image overlay by using georeferencing method", Proceedings of 16th International Radar Symposium (IRS), International Radar Symposium Proceedings, H. Rohling (Ed.), pp. 876-881. Dresden, 2015, DOI:10.1109/IRS.2015.7226230

[4] J. Łubczonek, and M. Borawski, "Comparative analysis of radar image compression methods", Proceedings of 16th International Radar Symposium (IRS), International Radar Symposium Proceedings, H. Rohling (Ed.), pp. 1117-1122. Dresden, 2015, DOI:10.1109/IRS.2015.7226237

[5] W. Kazimierski, and N. Wawrzyniak, "Exchange of Navigational Information between VTS and RIS for Inland Shipping User Needs", Mikulski J.(ed.) Telematics in the Transport Environment, Book Series: Communications in Computer and Information Science 471, pp. 294-303. Ustron, 2014, DOI: 10.1007/978-3-662-45317-9_31

[6] J. Lubczonek, "Application of GIS Techniques in VTS Radar Stations Planning". Edited by: Kawalec, A, Kaniewski, P., 2008 International Radar Symposium, pp. 277-280. Wroclaw, 2008, DOI:10.1109/IRS.2008.4585766

[7] J. Lubczonek, "Application of Modified Method of Viewshed Analysis in Radar Sensor Network Planning on Inland Waterways", 13th International Radar Symposium (IRS 2012), 5th Microwave and Radar Week, pp. 269-274.Warszawa, 2012, DOI:10.1109/IRS.2012.6233329

[8] W. Kazimierski, "Problems of Data Fusion of Tracking Radar and AIS for the Needs of Integrated Navigation Systems at Sea". 14th International Radar Symposium (IRS), vol.1 and 2, Book Series: International Radar Symposium Proceedings, pp. 270-275. Dresden, 2013.

[9] A. Stateczny, J. Lubczonek, and T. Kantak, "Radar Sensors Planning for the Purpose of Extension of River Information Services in Poland". Proceedings of 16th International Radar Symposium (IRS), International Radar Symposium Proceedings, H. Rohling (Ed.), pp. 858-863, Dresden, 2015, DOI: 10.1109/IRS.2015.7226251

[10] W. Kazimierski, and A. Stateczny, "Radar and Automatic Identification System track fusion in an Electronic Chart Display and Information System". The Journal of Navigation vol. 68, issue 6, pp. 1141 - 1154 2015, DOI: 10.1017/S0373463315000405

[11] T. Hyla, W. Kazimierski, and N. Wawrzyniak, „Analysis of Radar Integration Possibilities in Inland Mobile Navigation", Proceedings of the 16th International Radar Symposium (IRS), International Radar Symposium Proceedings, Dresden, Germany, H. Rohling (Ed.), pp. 864-869, 2015, DOI: 10.1109/IRS.2015.7226379

[12] A. Stateczny, "Radar Water Level Sensors for Full Implementation of the River Information Services of Border and Lower Section of the Odra in Poland", Proceedings of 17th International Radar Symposium (IRS), K. Kulpa (Ed.). Krakow, 2016.

[13] M. Wlodarczyk-Sielicka, and M., A. Stateczny, "Clustering Bathymetric Data for Electronic Navigational Charts", The Journal of Navigation pp.1-11, 2016, DOI:10.1017/S0373463316000035

[14] W. Maleika, "Moving Average Optimization in Digital Terrain Model Generation Based on Test Multibeam Echosounder Data", Geo-Marine Letters, 35, 61-68, 2015.

[15] W. Maleika, "The Influence of the Grid Resolution on the Accuracy of the Digital Terrain Model Used in Seabed Modelling". Marine Geophysical Research, 36, 35-44, 2015, DOI: 10.1007/s00367-014-0389-8

[16] W. Maleika, "Development of a Method for the Estimation of Multibeam Echosounder Measurement Accuracy", Przeglad Elektrotechniczny, 88 (10B), 205–208, 2012.

[17] W. Maleika, M. Palczynski, and D. Frejlichowski, "Effect of Density of Measurement Points Collected from a Multibeam Echosounder on the Accuracy of a Digital Terrain Model", 4th International Scientific Asian Conference on Intelligent Information and Database Systems (ACIIDS), Edited by: Pan, JS., Chen, SM., Nguyen, NT., Book Series: Lecture Notes in Artificial Intelligence, vol. 7198, pp. 456-465, Kaohsiung, Taiwan 2012, DOI:10.1007/978-3-642-28493-9_48

[18] W. Maleika, "The influence of track configuration and multibeam echosounder parameters on the accuracy of seabed DTMs obtained in shallow water", Earth Science Informatics, vol. 6, issue 2, pp. 47-69, 2013, DOI: 10.1007/s12145-013-0111-9

[19] N. Wawrzyniak, and T. Hyla, „Managing Depth Information Uncertainty in Inland Mobile Navigation Systems", Proceedings of the Joint Rough Set Symposium, Granada and Madrid, Spain, Kryszkiewicz et al. (Eds), Lecture Notes in Artificial Intelligence, vol. 8537, pp. 343-350, 2014, DOI: 10.1007/978-3-319-08729-0_35

978-1-5090-2421-6/16/$31.00 ©2016 IEEE

[20] T. Hyla, N. Wawrzyniak, and W. Kazimierski, „Model of Collaborative Data Exchange for Inland Mobile Navigation", Proceedings of Soft Computing in Computer and Information Science Conference, Advances in Intelligent Systems and Computing, vol. 342, pp. 435-444, Miedzyzdroje, 2015, DOI:10.1007/978-3-319-15147-2_36

[21] A. Janowski, A. Nowak, M. Przyborski, and J. Szulwic, „Mobile Indicators in GIS and GPS Positioning Accuracy in Cities", Proceedings of the Joint Rough Set Symposium, Kryszkiewicz et al. (Eds), Lecture Notes in Computer Science, vol. 8537, pp. 309-318. Granada and Madrid, 2014, DOI: 10.1007/978-3-319-08729-0_31

[22] P. Burdziakowski, A. Janowski, A Kholodkow et al., "Maritime Laser Scanning as the Source For Spatial Data", Polish Maritime Research, vol. 22, issue 4, pp. 9-14, 2015, DOI: 10.1515/pomr-2015-0064

[23] W. Kazimierski, and G. Zaniewicz, "Analysis of the Possibility of Using Radar Tracking Method Based on GRNN for Processing Sonar Spatial Data", Proceedings of the Joint Rough Set Symposium, Spain, Kryszkiewicz et al. (Eds), Lecture Notes in Artificial Intelligence, 8537, pp. 319-326. Granada and Madrid, 2014, DOI: 10.1007/978-3-319-08729-0_32

[24] M. Blazek, M. Kazimierczak, A. Janowski, K. Mokwa, M. Przyborski, and J. Szulwic, "An unorthodox view on the problem of tracking facial expressions", Federated Conference on Computer Science and Information Systems (FedCSIS). ACSIS-Annals of Computer Science and Information Systems, vol. 2, pp. 85-91. Warszawa, 2014, DOI: 10.15439/2014F495

[25] M. Blazek, A. Janowski, M. Kazimierczak, M. Przyborski, and J. Szulwic, "Web-Cam as a Means of Information about Emotional Attempt of Students in the Process of Distant Learning", 7th International Conference of Education, Research and Innovation (ICERI), pp. 3787-3796, Seville, 2014

978-1-5090-2421-6/16/$31.00 ©2016 IEEE