ISIM

TIMIŞOARA

SCIENTIFIC AND TECHNICAL REPORT (extract)

Project title: **Knowledge-Based System for Welded Structures and Technologies**

Stage 2: **Design, development and validation of the knowledge-based system for welded structures and technologies**

Project code: **COFUND-MANUNET III-KBS-Weld**
Financing Contract no. **25** from **01/03/2018**

Project coordinator: ISIM Timisoara, Romania

Project partners: SAM ROBOTICS SRL, Romania
Izertis SL, Spain

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CONTENT
of the Scientifical and technical report (RST) in extenso

ANNEXES:

Annexe 1: Results of the experimental testing program. Tests, examinations and analyses reports

Annexe 2: Workshop for dissemination of the project results
– Agenda of the event
– Paper presented during the workshop
– Workshop report

Annexe 3: Media campaign, publications in scientific journals
– Scientific paper in "Welding & Material Testing" journal
– Media campaign in Romania and Spain

Summary

Welding is an essential manufacturing process implemented in almost every major industry, welds quality and integrity being essential for the safety of a wide range of products and structures.

In this context, the COFUND-MANUNET III project, acronym: KBS-Weld, contract 25 from 1st of March 2018, entitled "Knowledge-Based System for Welded Structures and Technologies", aims at developing a knowledge-based system that works as a computing support for planning the welding process, allowing the end-users to choose the best combinations of welding materials, welding technologies and welding parameters to create the welded structure with the required properties.

For implementation of the COFUND-MANUNET III-KBS-Weld project, a consortium of the following institutions in Romania was established:
- Project Coordinator (CO) - National Institute for Research and Development in Welding and Material Testing - ISIM Timisoara;
- Partner (P): S.C. SAM ROBOTICS SRL, Timisoara.

COFUND-MANUNET III-KBS-Weld project consortium is completed by the European partner: Izertis S.L, Gijón, Spain.

All partners of the consortium participated in implementation of the stage 2/2019. The project management ensured that the planning and implementation of the activities foreseen in the implementation plan were achieved, which led to the fulfilment of the phase 2/2019 specific objectives:

- SO3. Construction of an advanced and easy-to-use model for the correlation and optimisation of input and output data of a welding process;
- SO4. Integration of computational components and validation of the whole ICT system at lab scale.

To achieve the current stage objectives, the following scientific and technical activities were carried out:

Project management:

- Supervising the activities to be implemented;
- Organization of the project team meetings in Romania and Spain;
- Organization of the project workshop for dissemination of the project results;
- Communicating with the managing authority and reporting the results.

Thus, during the stage 2/2019, the CO has managed, analysed and synthesized the partial scientific and financial data received from project consortium partners, data that were stored and processed.

Design of the knowledge-based system for welding design:
- Provide relevant technical data for system analysis;
- Defining the system structure and making a detailed specification of the various information system components;
- Defining the input-output model for the welding process, through which the knowledge of database, as well as the correlations obtained during the experiments are entered into the system;
- Define how to optimize the welding planning, taking into account different technical or financial criteria.

Implementation of the Knowledge-Based System for Welding Design:

- Implementation of the KBS-Weld system, design and developing of a user interface for its easy use;
- Elaboration of the operating and exploitation required information to ensure the correct functioning of the KBS-Weld system.

Preliminary validation of the KBS-Weld system:

- Design and implementation of the program for KBS-Weld software validation;

Dissemination of the project / project results:

- Updating the project website;
- Organization of an event for dissemination of the project results in Spain;
- Publication of scientific papers in scientific journal or presented in national / international events;
- Coordination of the media campaign in Romania and Spain.

In the frame of the project stage 2/2019, the KBS-Weld project website was updated. It could be accessed on: http://kbs-weld.ro.

All activities carried out and the results obtained during implementation of the stage 2/2019 are described in detail in this scientific and technical report (RST) in extenso.

Conclusions

During the stage two of the KBS-Weld project the conception, design, implementation and integration of the functional modules related to the knowledge-based system for welded structures and technologies was performed.

Machine learning and calculation algorithms have been established and implemented for the correlations between the input and output data of the welding process. Also, the graphical user interface was designed and implemented, being used for testing the IT modules and their integration according to the system architecture, as well as for the preliminary validation in laboratory conditions of the KBS-Weld platform.

The KBS-Weld platform serves as a software tool for professionals in the welding structures and components industry. There the users can find useful information on base material and filler materials for welding, welding parameters, welding experiments and related results obtained by testing them on the platform.

It has been proven that by exploiting the data generated by advanced machine learning techniques, the system can provide an optimal combination of materials and welding parameters for welded structures that meet the requirements specified by the end users.

The system helps to reduce the costs related to the preliminary experiments and the tests that have to be performed in order to develop the WPS (Welding Procedure Specification).

The platform developed within the project is based on "cloud" technology meets the requirements of performance, availability, reliability, scalability and security, being designed and built on the basis of independent modular components, thus facilitating the integration of several modules that ensure the flexibility and adaptability of the solution.

Bibliography (selection)

- Regression diagnostics: Identifying influential data and sources of collinearity, by D. A. Belsley, K. Kuh and R. E. Welsch

- Lightgbm: A highly efficient gradient boosting decision tree", G. Ke et al., Proc. Adv. Neural Inf. Process. Syst., pp. 3149-3157, 2017.

- Cortes, Corinna, and Vladimir Vapnik. "Support-vector networks." Machine learning 20.3 (1995): 273-297.

- Stone M. Cross-validatory choice and assessment of statistical predictions. J. Royal Stat. Soc., 36(2), 111–147, 1974.

- https://gitlab.com

- https://www.atlassian.com/es/software/bamboo

- https://www.sonarqube.org/

- K. Manikya Kanti, P S Rao, Rangajanrdhan, AMA Rani (2014), Mathematical Modeling for the Prediction of Depth of Penetration in Double Pulse GMA Welding Using Fractional Factorial Method, Applied Mechanics and Materials, 660, 347-351.

- * * * ISO 9692 Weld Joint Preparation.