



HORIZON-CL4-2021-TWIN-TRANSITION-01-07: Artificial Intelligence for sustainable, agile manufacturing (IA)

Ideas for the project:

There is a variety of reasons for the installation of a monitoring system in a manufacturing process. Hole making process is one of the most common operation used and usually is carried as one of the last steps in the production process. For the manufacturers of critical components (aero engines, space crafts) it is important to assess the quality of these at an early stage in the manufacturing of the product. The use of commercially available monitoring systems in hole making has not been successful in individual cases so far. Major reason for this lack of effectiveness are the large material variations within one production batch, the overall difficult machinability of the materials applied, the small lot size which makes “tech-in” operations ineffective. Today’s computer technique enables us to utilize neural networks as a robust tool in modelling, prediction and decision making process in machining process monitoring. Efficient methodologies and procedures are required to acquire the appropriate signals directly from the machine tool control unit and effectively process them in real-time to considerably reduce scrap production. Artificial intelligence tools are required for signal processing to help identify the conditions of the cutting tool corresponding to the surface anomalies on the machined component. In spite of the intensive research being carried out in this field, there is still no clear methodology for developing machining monitoring systems that allows machining processes to be optimized, predicted or controlled.

The proposed Advanced Monitoring System “AMOS” meets all the prerequisites to significantly reduce the production time and the amount of scrap in the production process, thus drastically reducing the price of the finished products. The AMOS can be utilised by component manufacturers to obtain the information about the integrity parameters of the machined surface and the sub-surface layer, as well as the condition of the cutting tool and its real-time optimal usage, significantly increasing the economic competitiveness in the global market.

Experience and infrastructure offered:

1. Up to date infrastructure for manufacturing and testing of processes and prototypes (see technology at [Home \(tuke.sk\)](http://Home.tuke.sk) and [Welcome to the Frontpage! \(tuke.sk\)](http://Welcome.to.the.Frontpage!.tuke.sk))
2. Test bed with digital twins for optimisation of machining process parameters in real time
3. Big sets of manufacturing data collection and their evaluation
4. Advanced monitoring techniques for tool condition as well as surface integrity identification

Projects solved, related to the issue:

1. Development of intelligent monitoring system for zero-defect production of irreplaceable parts (national research grant – Mankova, Vrabel, Vargovcik), see Mankova, I. - Vrabel, M. – Vargovcik, L.- Eckstein, M.: Intelligent Monitoring System for Zero-defect Production of Irreplaceable Parts. Lecture Notes in Mechanical Engineering, Springer Nature s. 147-156. - ISBN 978-3-030-31342-5
2. Utilization of artificial intelligence during machining of difficult to cut materials like titanium and/or nickel based superalloys for process monitoring (PhD thesis - Vrabel)
3. Development of Advanced Monitoring System for Machining Process of Hard and Difficult-to-cut Materials of Aeronautic Components (ESA proposal under revision process - Vrabel)
4. Adaptive Control of Manufacturing Processes for a New Generation of Jet Engine Components (7th FP)

Partners in previous research projects:

Universita Degli Studi Di Napoli Federico II, RWTH Aachen University, Mondragon University, Otto von Guericke University Magdeburg , University of Miscolc , Óbuda University , University of Novi Sad , Cracow University of Technology , Czeřochowa University of Technology , Tomas Bata University

Contacts to industrial partners:

CERN, Oerlikon, Minebea, Eli Beamlines, Schunk, Latécoère, SWEP, AIRBUS, Magna P, Sonaca, MASAM

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