Preface

In the manufacturing industry, the machining of medium and big size parts within the required precision is a challenge, especially in high added value products manufactured in small or single-unit batches made of high-performance materials like in aeronautic, space or energy sectors, where conventional process engineering and test/error methods are not completely efficient.

The performance of the machining process is not only affected by direct factors like the machine tool behaviour or the process definition; other secondary factors are able to change the whole system behaviour and the result of the machining process.

One of these factors is the fixture, whose main and traditional functions are to securely hold and accurately locate the workpiece considered as an undeformable body. Nowadays, the volume of produced compliant thin-walled parts is increasing due to lightweight design of many sophisticated products. The increasing demand on the precision and the need of increasing the performance of the manufacturing processes drive to other important functions of the fixtures considering aspects like the deformations, vibrations and distortions of the workpiece during processing.

In this situation, the machining system consisting of the machine, fixture and workpiece cannot be considered as a stable unit due to its dynamic behaviour and geometrical shape variations along the process. So, it is reasonable to use the fixture to control and adapt the behaviour of machining systems to improve the performance.

New technologies—including sensors, actuators as well as Information and Communication Technology (ICT)—allow the development of intelligent fixture systems, enabling the monitoring, control and adaptation of the clamping and the process conditions to obtain suitable results according to precision, quality and cost requirements.

The INTEFIX project aimed to establish fixture design methodologies taking advantage of the available state-of-the-art software and hardware tools (e.g. sensors, actuators, CAD/CAM/CAE, CNC, PLC, process simulation tools) combined with ad hoc ICT tools (e.g. control algorithms, simulation tools) to control and adapt the behaviour of the fixture, resulting in the development of intelligent fixture systems.

The impact of the INTEFIX project is not only located in the field of machining processes, as the intelligent fixture concepts can be extended to other processes such as welding, repair or mechanical assembly.

The INTEFIX project was performed in a series of case studies divided into three parts oriented to obtain a solution to different problems associated to machining processes:

- Part I: Vibration. The intelligent fixture counteracts vibration problems during machining by changing the dynamic properties, stiffness, damping, etc.
- Part II: Deformation. The intelligent fixture counteracts the deformation or distortions of the workpiece associated to process/clamping forces or residual stress relieving.
- Part III: Positioning. The intelligent fixture produces small movements or corrections to counteract linear and angular positioning errors of the workpiece.

The developed solutions are validated in eleven real case studies from the aeronautic, railway, automotive and machine tool sectors covering different problems and requirements in the manufacturing industry.

Each case study established collaborations between different partners with supplemental capabilities needed to perform the required technological development. This includes an end user who defined the requirements and main objectives of the case study, different technology suppliers who provided base technologies used for the development of the solution, and a technology integrator who designed the fixture. Thus, bringing together the required critical mass in the entire value chain and connecting the end users in the manufacturing industry with the product innovators and the systems integrators.

The partners of the INTEFIX project are: IK4-TEKNIKER; IK4-IDEKO; OTTO-VON-GUERICKE-UNIVERSITAET MAGDEBURG; TECHNISCHE UNIVERSITÄT DORTMUND; RCMT OF THE CZECH TECHNICAL UNIVERSITY IN PRAGUE; CECIMO; BCT; COMPO TECH; INVENT; DR MATZAT & CO; ROEMHELD; GIGGEL; STERN HIDRAULICA; CEDRAT TECHNOLOGIES; ALAVA INGENIEROS; INDUSTRIA DE TURBO PROPULSORES; DEHARDE; SORALUCE; GOIMEK; STROJIRNA TYC; KALE HAVACILIK; TECNALIA; GAMESA ENERGY TRANSMISSION; MARPOSS; UNIVERSITA DEGLI STUDI DI FIRENZE; PARAGON; GIRARDINI; TECMA; BEREIKER; ZAYER; MESUREX; and WOELFEL.

The case studies treated in the project resulted in a series of specific solutions to improve the limitations presented by the end users, and several generic standalone products able to perform specific tasks in the fixture field or in general applications.

Eibar, Spain Oscar Gonzalo

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Möhring, H.-C.; Wiederkehr, P.; Gonzalo, O.; Kolar, P.

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