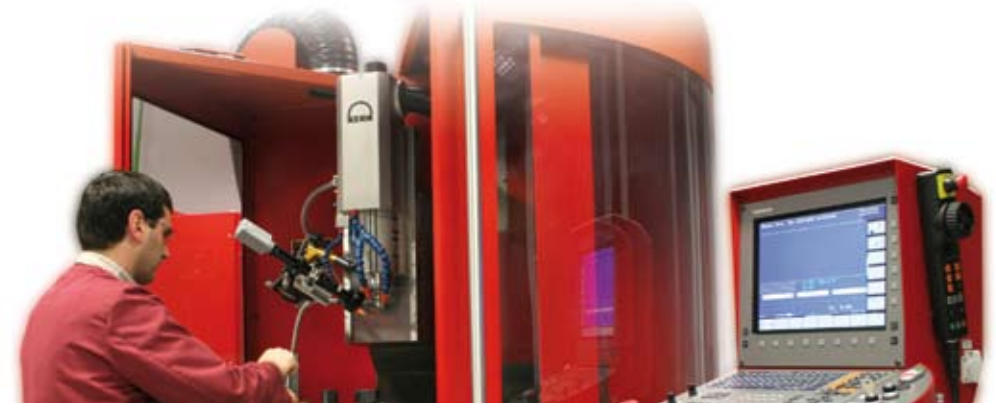
HIGH PERFORMANCE CUTTING



DESCRIPTION

The main goals of the High Performance Cutting research group are to improve machining processes employed in different industrial sectors (transport, aeronautics, health, machine-tool, moulds and dyes…) and to generate new ideas to manufacture innovative products that will enable entry into new markets or even lead to the launch of new companies.

RESEARCH TOPICS

High Speed Cutting: High speed cutting is used in sectors as diverse as aerospace or moulds and dies. Research is carried out in the optimization of the high speed cutting of (I) free form surfaces of hardened steels (moulds and dyes) and (II) workpieces of titanium alloys.
Micromachining: Miniaturization is nowadays a global trend which affects a manufacturing process in several production markets as TICs, electronics or biomedicines. This size reduction implies some process changes, making it more difficult and less reliable. A micromachining laboratory has recently been set up in order to improve knowledge of micromachining, hence its performance.
Abrasive Processes: Grinding is the most important finishing technology among the abrasive processes to obtain parts with a good surface finish and close geometric and dimensional tolerances. The aim is to predict the behavior of the main parameters (wheel, machine, working conditions, workpiece, ..) taking part in the process, using simulation models based on knowledge. Intelligent and machine integrable tools are developed with the goal of the process optimization interrelating productivity and process cost.
Chip formation Study and modelling: The fundamental knowledge of cutting is the basis for optimising any machining operation. The combination of experimental tests together with modelling allows better understanding of the material removal process, helping the selection of cutting conditions or even the development of new cutting tool and workpiece materials.
Machinability: Machinability refers to the ease with which a part or material can be machined. Therefore, it is very important to find ways to improve machinability without harming performance. Currently, the research is focused on the study of this property with the most advanced experimental techniques in different materials: steels, titanium alloys, inconel, cast iron,...
Biomachining: The research in biomachining is focused on the study of cutting process of biological materials such as bone, cartilage or soft tissue aiming to minimize the damage during the procedure. The main goal is reduce the recovery time of patients after surgical interventions.
Intelligent Machining: The research is focused in the the development of Adaptive Machining Systems for metal cutting operations (milling, turning, drilling, grinding), which consist of sensor and actuator systems for online manufacturing control related to the part quality. The major aim is to achieve an Online Quality Control system to satisfy demands for mass customisation and small batch production.
Knowledge Base Engineering (KBE): The objectives of KBE or CAX software customization are: firstly, to increase the productivity of CAX software users; secondly, to capture and keep the Product Life Cycle Knowledge as a company asset; and finally / thirdly, to speed up the integration of new employees by giving them access to company's Product Life Cycle Knowledge as required in a reusable format.

MOST RELEVANT PROJECTS

	PROJECT
FP7-NMP-2007-SMALL-1 Manunet (ERANET)	ADACOM- Adaptive Control for Metal Cutting.
Sixth Framework Programme	ADVANTICUT- Development of Advanced Tools and High Performance Cutting Processes for Machining Titanium Alloys.
Singular and Strategic Projects (Spanish Government)	PROMACH; Development of a machinability index for steels with different microstructures.
	MICROMANUFACTURING; Desarrollo de tecnologías de microfabricación innovadoras para la generación de nuevos negocios y el incremento de la competitividad de la industria española en mercados incipientes.

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PROGRAM	PROJECT
ETORGAI (Basque Government)	TIMIN- Tratamiento integral mínimamente invasivo.
CENIT (Spanish Government)	OPENAER; Nuevas configuraciones de avión y motor para el futuro sistema de transporte aéreo.
Collaborative Applied Research (Spanish Government)	TERMES; Modelización térmica y mecánica del proceso de rectificado.
Scientific Research (Spanish Government)	MAQUIMODEL; Desarrollo del conocimiento de base sobre la propiedad de la maquinabilidad reflejado en nuevos modelos del contacto viruta – herramienta para su implementación en la modelización del mecanizado.
Nets (Basque Government)	PROSENS; Desarrollo de un novedoso sensor como producto de gran interés para el monitorizado del contacto en procesos de precisión.
Saiotek (Basque Government)	COMATI II; Definición de condiciones óptimas de mecanizado e incremento de la productividad en la aleación de titanio Ti6Al4V.
Etortek (Basque Government)	MANUFACTURING 0,0.

PHD THESIS

Joseba Pujana: "Experimental characterisation of the chip formation process and its application to determine the parameters of the material behaviour law by inverse identification". October 2007. Supervisors: Pedro J. Arrazola, I. Gallego.
Endika Gandarias: "MICROM: a revolutionary monitoring system to detect tool breakages & collisions, enhance machine cycles and introduce a new probing concept in micro-milling". July 2007. Supervisors: Pedro J. Arrazola, I. Gallego.
José Ignacio Marquinez:"Geometric lobing suppression in centerless grinding by new simulation techniques". December 2008. Supervisor: I. Gallego.
Jon Madariaga: "Predictive models to control thermal damage and tribological instabilities in grinding processes". February 2009. Supervisors: I. Gallego, W. Tato.
Unai Segurajauregi: "Methodology for the characterization and identification of the amount of heat going in the workpiece during machining operations in order to obtain parts of high dimensional quality". November 2009. Supervisor: P.J. Arrazola.
Iñigo Llanos "Development of predictive models oriented to study the surface integrity during cutting". January 2010. Supervisor: P.J. Arrazola.
Iban Arriola "AISI 4140 Steels' machinability comprehension analyzing in-process parameters by advance measurement techniques". January 2010. Supervisor: P.J. Arrazola.

PUBLICATIONS

- Arrazola, P.J., Garay, A., Iriarte, L.M., Armendia, M., Marya, S., Le Maître, F. 2009 Machinability of Titanium alloys (Ti6Al4V and Ti555.3). Journal of Materials Processing Technology. Vol 209, nº5, pp:2223-2230.
- Jemielniak, K., Bombinski, S., Aristimuno, P.X.2008 Tool Condition Monitoring in Micromilling Based on Hierarchical Integration of Signal Measures. Annals of the CIRP, 57/1.121-214.
- Arrazola, P.J., Arriola, I., Davies, M.A., Cooke, A.L., Dutterer, B.S., 2008. The Effect of Machinability on Thermal Fields in Orthogonal Cutting of AISI 4140 Steel. Annals of the CIRP, 57/1.65–68.
- Arrazola, P.J., Ugarte, D., Domínguez, X., 2008, A new approach for the friction identification during machining through the use of finite element modelling, International Journal of Machine Tools & Manufacture, 48,73–183.
- Pujana, J., Del Campo, L., Pérez-Sáez, R.B., Tello, M.J., Gallego, I., Arrazola, P.J., 2007, Radiation thermometry applied to temperature measurement in the cutting process, Meas. Sci. Technol. 18 (2007) 1–8.
- Gallego, I., Intelligent Centerless Grinding: Global Solution for Process Instabilities and Optimal Cycle Design. Annals of the CIRP, 56/1: 347-352.
- Pujana, J., Arrazola, P.J., M'Saoubi, R., Chandrasekaran, H., 2007, Analysis of the inverse identification of constitutive equations applied in orthogonal cutting process, International Journal of Machine Tools and Manufacture, 47, 2153–2161.
- Gandarias, E., Dimov, S., Pham, D.T., Ivanov, A., Popov, K., Lizarralde, R., Arrazola, P.J., 2006, New methods for tool failure detection in micro-milling. Journal of Engineering Manufacture, 220 (B2), pp. 137-144.

PATENTS AND INTELECTUAL PROPERTY

- E. Gandarias and I.Gallego: Tool and Spindle Condition Monitoring System in a machine-tool.
- P.J. Arrazola. Finite Element Model of Chip Formation Process. I.P.R.: Right V-356-07.

FACILITIES

Workshop: Micromilling machine Kern Evo (50.000 rpm/160.000 rpm), High Speed Milling machines LAGUN (18.000 rpm) and Kondia (12.000 rpm), CNC Lathes, C.N.C. Grinding machine GER, Force sensors (turning, drilling, milling, micromilling,grinding), Accelerometers, IR camera Titanium 550M, Software (Unigraphics, Abaqus, AdvantEdge, Deform), Metrology (MMC, Rugosimeter, Confocal perfilometer), Optical Microscopy (Scanning Electronic Microscope and Micronalysis).

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