



Università Politecnica delle Marche – UNIVPM is a medium sized university located in Ancona, central Italy. UNIVPM will participate to Grace project with the research group of Mechanical and Thermal Measurements, which is part of the Department of Industrial Engineering and Mathematical Science - DIISM, within the Faculty of Engineering.

www.meccanica.univpm.it/it/node/45



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Grace

inteGration of
pRocess and quALity
Control using
multi-agEnt
technology



Project funded by the European Community under the 'Seventh Framework Programme' (2007-2013) within the Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP) | Contract no. 246203

Grace

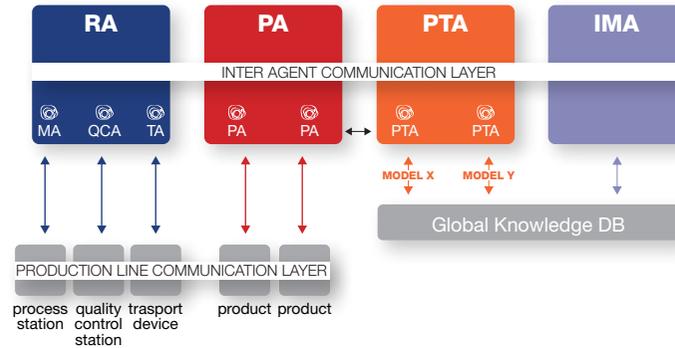
Traditional manufacturing control systems are not designed to exhibit the capabilities of responsiveness, flexibility, robustness and re-configurability they would need to face the rapid changes imposed by global competition and evolving requirements of customers. Indeed they are built upon centralized and hierarchical control structures, which present a good production optimization, but a weak response to changes.

Grace Vision

The Grace approach is in line with the needs to have modular, intelligent and distributed manufacturing control systems. The main objective of the GRACE project is to conceive, study, develop, implement and validate a collaborative Multi-Agent System (MAS) which operates at all stages of a production line. This innovation aims to introduce a new vision of the production process which leads to an easy integration of the process control with quality control at local and global levels.



The Grace system will act at the Distributed Control System (DCS) and Manufacturing Execution System (MES) levels, implementing the sharing of process critical information between and inside the two layers. This results in a more efficient management of resources and a higher final product quality.



- AGENTS**
- IMA independent meta agent
 - Product model**
 - PTA product type agent
 - Local schedule**
 - PA product agent
 - RA resource agent
 - MA machine agent
 - QCA quality control agent
 - TA transport agent
 - OA operator agent

Grace approach will be demonstrated on a real case study, by implementing the architecture on a washing machines production line.

System Architecture

The manufacturing assembly systems and the quality control stations of a production line will be treated as intelligent agents. The whole production process will be supervised and controlled through the integrated and coordinated operation of a network of collaborative individual agents. Each agent has its own objectives and behaviours and possesses its own perceptive and cognitive capabilities.

The main entities defined within the Grace architecture are:

Product Type Agent (PTA) represents the catalogue of products parts and contains the process and product knowledge required to produce the product.

Product Agent (PA) manages the production of product instances in the plant/production line.

Independent Meta-Agent (IMA) implements a global supervisory control, optimized planning and decision-making mechanisms. It receives data, features and decisions of all individual agents, and also feed data to the Global Knowledge Data Base.

Resource Agent (RA) associated to the physical resource of the production line, it manages the execution of its production/testing/assembly operations. Different specializations of the RA exist namely Machine Agent (MA), Quality Control Agent (QCA), Transport Agent (TA), Operator Agent (OA).

Benefits

The Grace architecture can be applied to production lines in several areas of manufacturing, with the following benefits:

Self-adaptability to desired variation of process set-points and process variables and to unplanned fluctuations of process/product parameters

Adaptation and self-learning mechanisms in systems for automatic quality control at local and global level

Maximization of production efficiency and product quality through improved effectiveness of feed-forward and feed-back control loops, based on a continuous flow of information among agents

Improvement of factory-level decision making strategies based on data analysis exploiting information from all processes and building up an historical data base

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