Robot path planning and programming

• State of the art simulation tools (DELMIA, Robcad)
• Intelligent path planning
• Off Line Programming (OLP) of industrial robots
• Applications include
  o Welding
  o Handling
  o Assembly

Virtual commissioning (VC) of flexible robotic cells

• Complete workflow for applying VC techniques on industrial assembly cells

• Development of complete cell mechatronic model including:
  o Detailed 3D modeling (geometry, kinematics, robot programs etc.)
  o Complete behavioral modeling (I/O signals, control logic, safety features etc.)

• Reliable way of validating the operation of a cell prior to each installation
  o Ramp-up time reduction
  o Reduction of investment costs
  o Enhancement of re-configurability

S. Makris, G. Michalos and G. Chryssolouris, “Virtual Commissioning of an assembly cell with cooperating robots”, Accepted for publication in “Advances in Decision Sciences”, 2012
Design and analysis of flexible cells using cooperating robots

• Modeling and analysis of cooperative assembly tasks between robots

• Identification of cost, time and complexity implications, under different assembly applications


Robot programming using open source system such as ROS

- Implementation of communication between the cooperating robots through the use of ROS services

- PC based control of:
  - Arms,
  - Grippers
  - Guns
  - Auxiliaries

Development of robotic vision systems for the adjustment of welding processes

- Development and integration of stereo vision systems on industrial robotic arms for welding operations
- Use of laser diodes for highlighting the welding area and examination of the laser line distortion to correct the path of the robot

Integration of wireless technology (RFID, WiFi etc.) for the intelligent control of flexible robotic cells.

- Development of an integration driven framework for enabling the RFID based identification of parts to perform robotic assembly operations in a random mix.

- RFID infrastructure senses the arriving parts to be assembled and via the integration framework, the robots are able to recognize them and perform cooperative welding operations.

Design, modeling, simulation and optimization of robotic assembly lines

- Development and application of intelligent search algorithms for high quality line designs.
- Use of multi criteria decision making methods using as metrics:
  - investment cost
  - availability
  - equipment re-utilization
  - annual production volume
- Implementation of flexibility quantification methods in complete software tools

Robot structural integrity calculation using finite element modeling

- FE modeling of industrial robots
- Experimental validation and model adjustment for optimal results
- Static and dynamic modeling.
- Generic model development for case that detailed CAD files are not available

Static response calculation of industrial robots under external loading conditions

- FEA based stiffness map for industrial robots
- Color graded end-effector displacement representation
- Clear selection of most accurate robot poses and Efficient estimation of the resulting process accuracy level