INFORMATION

AEROSPACE MANUFACTURING TECHNOLOGY

Aircraft Assembly

The aerospace manufacturing sector is traditionally based on manual operations rather than automation because of the level of accuracy required in assembling aerospace structures. Canadian manufacturers are now realizing that to remain competitive they need to reduce costs by incorporating automation and intelligence into their processes.

The NRC Institute for Aerospace Research (NRC Aerospace) is helping Canadian aerospace companies develop and adopt cost-effective, flexible, reconfigurable approaches for aerospace structure assembly using robotics and automation. This will increase the scope of work that aerospace subcontractors can carry out for original equipment manufacturers. Projects are currently underway to develop low-cost reconfigurable robotized cells for aircraft component assembly and large-scale machining operations. Virtual manufacturing is also being investigated.

Capabilities
NRC Aerospace uses state-of-the-art virtual prototyping techniques to design and analyze manufacturing processes. These tools provide several advantages. The return-on-investment potential of new technologies can be evaluated without building physical prototypes and performance measurements such as cycle-time or work cell floor space can be provided. Robot work cell layout can be optimized, technical and financial impact evaluations of multiple automation scenarios can be shortened prior to making a big investment; and automatic trajectory generation/exportation of robot programs in native language can be provided.

Software tools for simulating aerospace manufacturing robotized processes include:

- Workspace 5.04 for kinematic simulation and off-line programming of small- to medium-scale robot work cells
- DELMIA V5 Robotics for kinematic simulation and off-line programming of medium-to large-scale robot work cells involving the importation of heavy CATIA V4 and/or V5 assemblies, and
- Simulink/SYMOFROS for kinematic and dynamical simulation of aerospace manufacturing processes involving complex mechanical systems.


Gantry system with industrial robots

Improvements are being made to commercial off-the-shelf calibration packages, which have difficulty dealing with error-contributing phenomena and which often exclude robot parameters from the kinemat ic identification process that ensure identification and parameter independency.

NRC Aerospace staff are also improving the efficiency of laser trackers which are used by the aerospace industry for tooling/ fixture setups, part inspection, and assembly component alignment by using computer-aided measurement planning to develop a fully automated process for

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determining the optimal measurement path for a given distribution of reflector locations. Advantages include elimination of uncertainties associated with an operator having to manually plan a complex measurement sequence and reduced overall measurement sequence cycle-time.

Applications

Various projects are currently underway related to development of low-cost reconfigurable robotized cells for aircraft component assembly. NRC Aerospace experts are working with Bombardier Aerospace on the design of a fully integrated vision system for drilling sequence and panel inspection, and design of robotized cell auxiliary hardware components. In another project, a hardware demonstrator to position panels for riveting operations is being developed. NRC Aerospace is also investigating orbital riveting of aircraft structures.

An automated self-calibration approach for industrial robots is being studied in simulation through a partnership with L3 Com. NRC Aerospace is also performing a hardware demonstration of automated spar assembly drilling that results in minimum burrs in a collaborative project with Avcorp.

Equipment

- Unique gantry robot system with three robots (used for developing technology demonstrators):
  - Gantry dimensions: 6 m x 6 m x 6 m (20’ x 20’ x 20’)
  - Rail-mounted KUKA 500 robot
  - KUKA 210 robot: 210 kg capacity
  - ABB 1440 robot: 60 kg payload
  - PushCorp active force end effector
  - Metavision cross-hair system
  - AMATEC 6-axis force controller
  - ALEMA multifunction end effector (drilling, sealant insertion, rivet insertion and impact) including visual servoing for robot registration
- Stewart platform for positioning
- Leica laser tracker for large-scale assembly and robot calibration
- Supervisory control system based on Opal-RT technology.

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