The Light Controlled Factory

Introduction and Methodology

The Light Controlled Factory is the factory of the future. The Light Controlled Factory will use networks of light-based measurement systems to enable increased automation in manufacturing and the flexibility to evolve and adapt to changing demands. This will increase production capacity and drive down costs improving the competitiveness of the British high value manufacturing sector. The factory will be able to rapidly adopt and utilise new measurement-enabled production technologies as they reach technological maturity.

Research Theme 1: Measurement assisted assembly technology with integrated processing machines

Challenges:
- Robots have poor absolute accuracy
- Robots have poor stiffness
- Robots are not designed to machine!

Proposed solution:
- Robotic manipulator with machining/processing end-effector
- Real-time position compensation using large volume metrology
- 5/6 DOF tracking using dual laser tracker or laser tracker and iGPS hybrid

Divide the task into low frequency and high frequency regions
- Laser tracker feedback for low frequency
- Active-vibration damping for high frequency

Research Theme 2: Model based and physical measurement methods for establishing the uncertainty of the spatial fidelity of large, complex tools and parts due to gravitational effects and thermal gradients

Challenges:
- Large (5-30m), often compliant parts being assembled
- Thermal gradients in factories (3-5°C)
- Thermal variation (15°C over 24 hours)
- Gravitational loading
- Monolithic tooling
- Measurement uncertainty 1.5 mm

Proposed Solution
Development of a novel Hybrid Metrology System combining physical measurement and computational simulation

Research Theme 3: A ubiquitous, 7D measurement environment for the entire factory space

Multi-camera system for tracking and positioning of multiple objects
Task requires multiple 6D data (X,Y,Z, roll, pitch, yaw) tracked over time, hence ubiquitous 7D system

Dimensional accuracies in working space are improved by:
- Many camera views which give multiple intersections of object targeting and mitigate environmental fluctuations
- Advanced camera models in conjunction with monochromatic imaging to eliminate distortions and optimise image quality

Camera analyses using selected monochromatic frequencies (red, green, blue, nir) show systematic variations, giving scope to improve accuracy. Example highlights principal distance variations.

A small-volume, multi-camera demonstrator has been assembled for system optimisation and performance testing against industry standards

Identification of a part from within a high density set of measured coordinates, and comparison of the part to a ‘gold standard’ model has important applications including:
- Robot Picking
- Process Control
- Dimensional Quality Control

Novel Maximum Likelihood 6DOF Localiser

Function
To match a view of the part to the gold standard maximising the probability of all surface matches.

Advantages
- Unified approach
- Avoid time consuming ICP algorithms
- Statistically Robust and Fast Runtimes

Industrial Partners, Academic Network and Industrial Forum

Following the success of the Light Controlled Factory track at the 2014 Digital Enterprise Technology International Conference, a new conference will be set up dedicated to Light Controlled Factory technologies.

We are building an Academic Network and Industrial Forum, if you are interested in joining either of these, please contact Prof. Paul Maropoulos: p.g.maropoulos@bath.ac.uk