



Reconfigurable Intelligent Precision Robotic Machining Machine

Jenq-Shyong Chen, Professor
Department of Mechanical Engineering
National Chung Hsing University

Conventional deburring and polishing processes: human hand processing

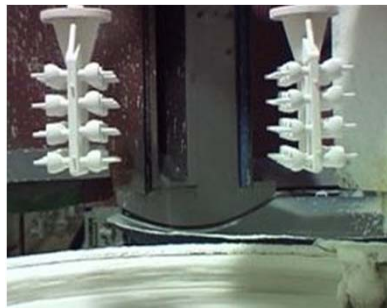


Fabrications of 3C electronic devices (such as smart phone, ultra-book and iPad) require a lot of human hand deburring and polishing of metal parts.

Medical Implants

Investment Casting

Human offhand Grinding/Polishing/Buffering



Gate removal grinding

Contour grinding

Profile grinding

Interior surface grinding

Polishing Buffering



High-gloss surfaces with Ra values below 50nm on the running surfaces of the knee joints



For the manufacturing of tools 12~15% of the manufacturing cost and 30~50% of the manufacturing time are allocated to polishing. Robot polishing offer potential to strengthen the European Tooling Industry by significant decrease of polishing costs (75%) and time (90%). [1]

[1] Automated polishing for the European tooling industry, Project reference-246001, European Seventh Framework Program (FP7-NMP), www.automated-polishing.eu

Polishing/deburring of complex geometric and free form surface parts

There is an increasing demand for production machines for the manufacture of

- workpieces with a large volume (e.g. 3C electronic devices) made within a short delivery time
- with a comparatively small amount of material to be removed (e.g. deburring and polishing)

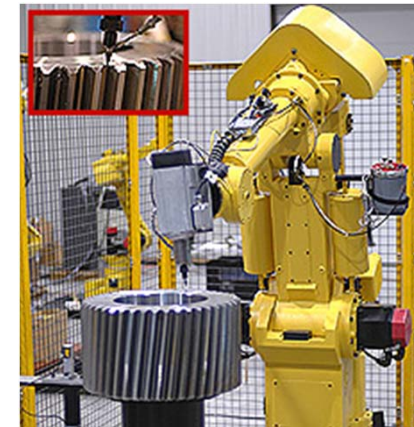


➔ These parts all require 3-axis or 6-axis machining capability

Robotic light machining system (deburring, polishing, grinding, and light milling)



VersaFinish ACT-390 Axially-Compliant Finishing Tool



Integration of Grinding/Milling/Polishing and AOI/CT in a dynamic 5-axis CNC Machining System

SIEMENS

+

Schütte



COMPLETE PRODUCTION IN A SINGLE CLAMP

The Schütte WU 305 linear universal CNC cutter grinder performs milling, grinding, belt sanding and polishing all in one operation



Rough grinding



Milling



Abrasive belt grinding

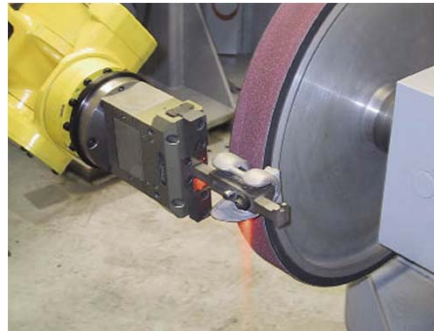


Polishing

Robotic Grinding/Polishing System (USA)



Fanuc S10 6-axis robot



The key benefit of robotic technology is increased productivity: it can take around 45-90 min to hand-polish and buff a femoral implant but a robot can achieve this, with perfect results, in 7-8 min. One implant manufacturer maintains that a single robot can typically do the work of around 10-15 people in this application. [1]

Comparisons of the conventional 5-axis machine tool and robotic machining process



Industrial robots will become the major workforces of future factory



Operator assisted loading/unloading machining machine



Robot loading/unloading machining system

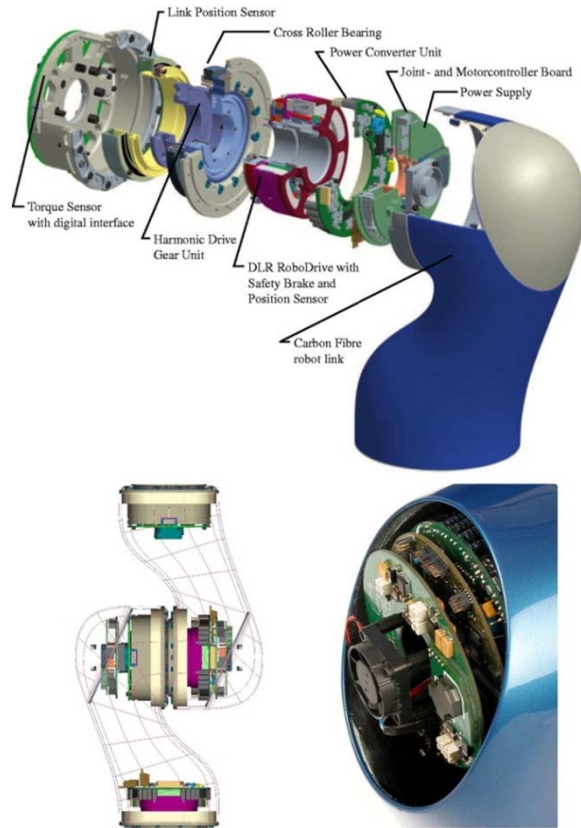


Two-in-one machining cell (or robot-inside machining machine)

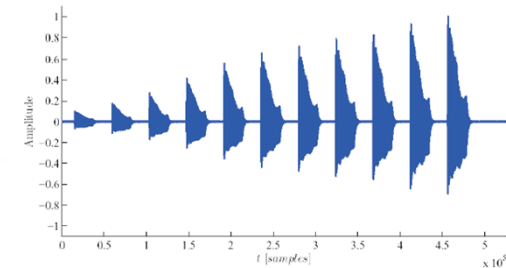


Robotic deburring machine

Modular mechatronic power joint of robots of DLR light weight robots

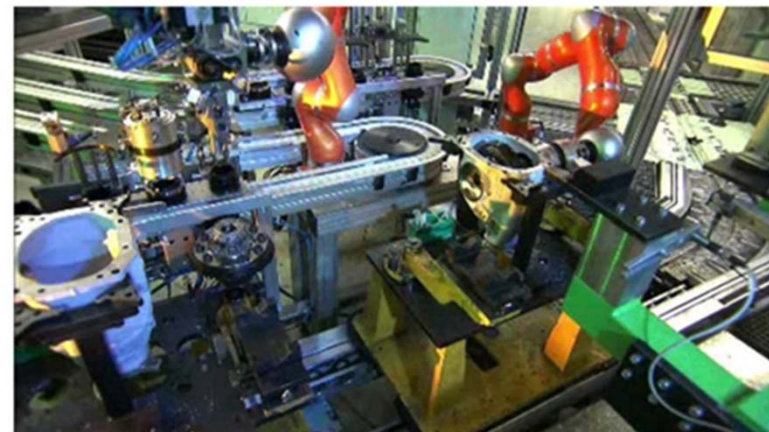


Soft robotics



Recorded piano sound signal demonstrating the ability to play at varying loudness

• More than 40,000 transmissions have been produced to date!



Comparisons of light weight robot and conventional industrial robot

DLR Light
Weight Robot III



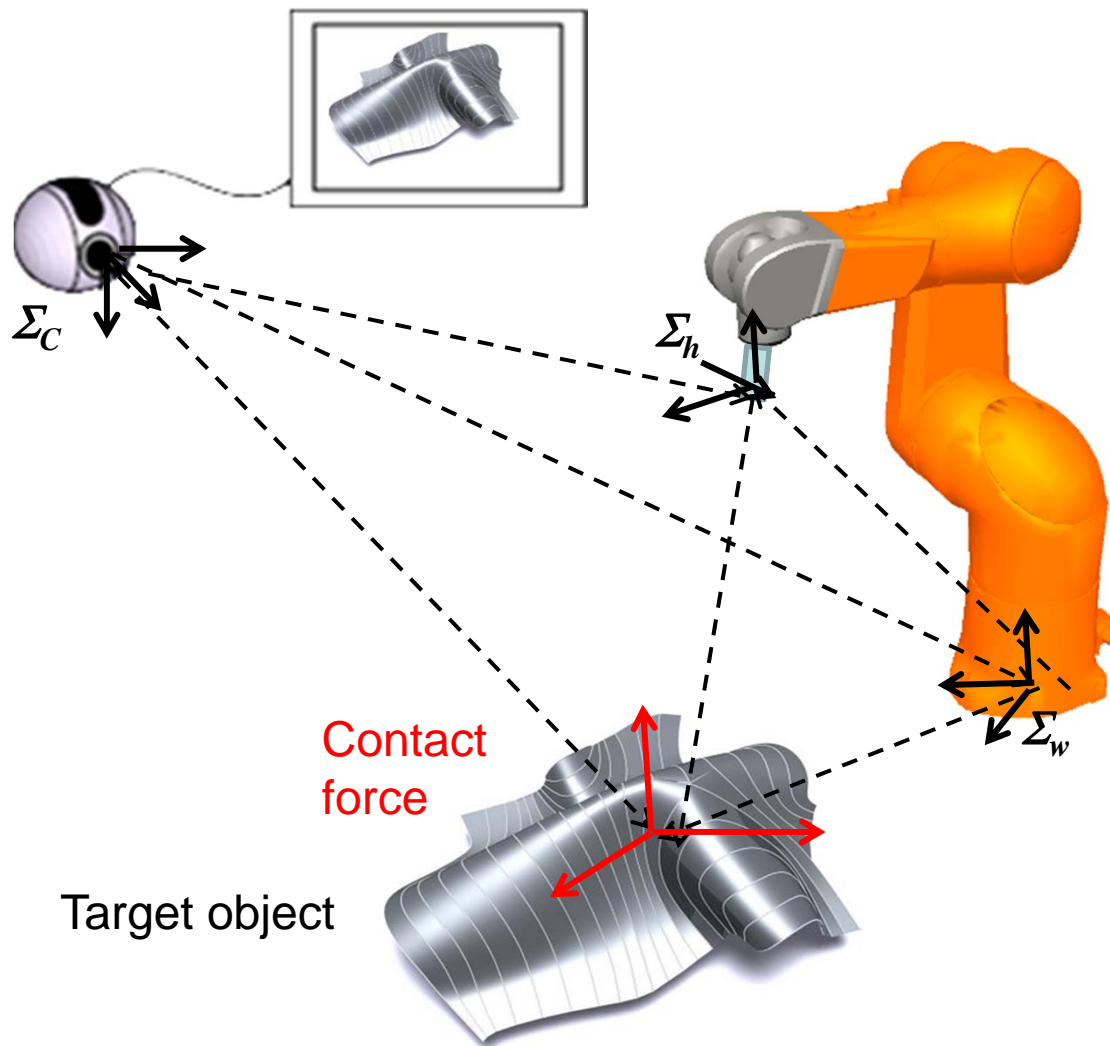
No. of axes: 7
Total weight: 14kg
Max. Payload: 14kg
Maximum reach: 936 mm
Torque sensor: yes

Fanuc LC
200iC/5C robot



No. of axes: 6
Total weight: 29kg
Max. Payload: 5kg
Maximum reach: 892 mm
Torque sensor: no

NCHU Reconfigurable intelligent precision robotic machining machine



Task 1
Fast calibration and measurement
technology of the spatial positioning
errors and path contouring errors

Task 2
High speed 3D objects
recognition and positioning

Task 3
Modular and reconfigurable
robotic light machining system

Task 4
Path planning and impedance
control of vision guided light
weight robot

Thanks for your attention!
