



CLEAN CUT

Manufacturing high-value products is generally complex as the products are made of exotic materials that are often difficult-to-machine and are usually of high-mix low-volume. Product miniaturisation has also resulted in the necessity to develop machining technologies capable of achieving even smaller feature sizes with greater accuracy. Thus, the need to develop a new generation of highly competitive machining competencies to support the aerospace, oil & gas, complex equipment, and medical products manufacturing industries has become the driving force in high performance machining. This trend requires an understanding and adaptation of issues in high precision cutting, machining dynamics, surface finishing, and novel or hybrid machining processes.

MTG focuses on three main research areas - to enable the manufacturing of products that have high initiative profiles, greater structural integrity yet display excellent surface finishes and machining efficiency, with high dimensional accuracy.

The group carries out collaborative research with various academic institutions, co-develops processes and products with companies, transfers technology, and conducts training for the manufacturing industry.

Core Competencies

Mechanical Precision Machining

- Ultra-Precision Machining of free-form surfaces
- Ultra-Precision Machining of roller moulds
- Precision machining of difficult-to-machine materials
- Machining dynamics for vibration reduction and chatter avoidance
- Multi-axis simultaneous machining modelling and simulation

- Micromachining of intricate micro features and micro channels
- Development of deep-hole drilling technology

Abrasive Processes

- Precision mass finishing of external and internal surfaces
- Magneto-Rheological Finishing (MRF) of free-form profiles to achieve optical surface finish

- Precision profile grinding
- Mechanised edge profiling, modification and deburring

Laser Precision Machining

- Laser surface texturing and surface processing
- Laser precision dicing and drilling
- Laser surface and sub-surface marking
- Laser micromachining

Technologies Available for Transfer

Mechanical Precision Machining

- Chatter avoidance/stable cutting strategy
- Dynamic Numeric Control verification and optimisation
- QuickNanoCAM for ultra-precision machining of lens array
- Ultrasonic vibration assisted diamond cutting of steel moulding inserts
- Ultra-precision machining of roller moulds

Laser Precision Machining

- Laser dicing of silicon wafer
- Laser marking
- Laser removal of packaging compounds for electronic component failure analyses

Abrasive Processes

- Abrasive Flow Finishing (AFM)
- Magneto-Rheological Finishing (MRF) of free-form profiles
- Grinding power monitoring and wheel selection
- Precision finishing of microstructured surfaces

Target Industries

- Aerospace • Automotive • Complex Equipment Components
- Computer-Aided Manufacturing/Computer Numerical Control (CAM/CNC) software • Die/Mould • Electronics Substrates • Medtech • Oil & Gas • Precision Engineering

Major Facilities

Mechanical Precision Machining

- High speed milling machine
- 5-axis CNC machining centre
- Ultra-precision 5-axis machining centre
- Ultra-precision single-point diamond turning machine
- Multi-axis turn-mill machine
- Deep hole drilling machine

Laser Precision Machining

- CO₂ laser system
- Excimer laser system
- Femtosecond and Picosecond laser systems
- Fibre laser
- Diode-pumped solid state ultraviolet laser
- High power 1060nm YAG laser

Abrasive Processes

- Vibratory bowl polisher
- 6-axis CNC cutter grinder
- Abrasive flow machining
- Creep-feed surface grinding machine

Measurement Equipment

- White light interferometer
- Stylus profilometer
- Dynamometers
- Microscope
- Vibration measurement sensors modal test equipment

Industry Partners

- Acculex Solutions
- Amtek Engineering
- Applied Materials Singapore Technology
- AvanStrate Asia
- AvanteK
- BD (Singapore)
- Blaser Swisslube
- Cragar Industries
- Delta Optics Technologies
- Eratech
- Fidel Engineering and Trading
- First Engineering
- Fong's Engineering and Manufacturing
- Getech Automation
- Goodrich Aerostructures Service Centre – Asia
- Hamilton Sundstrand
- Hewlett Packard Singapore
- IDI Laser Technology
- Innogrity
- Long Tech Engineering
- Meiban
- Micro-Mechanics
- Mikrotools
- Moveon Technologies
- Onn Wah Precision Engineering
- Resem Technologies
- Rolls-Royce
- Schlumberger
- Shimano (Singapore)
- Sky Engineering
- Stamford Tyres
- The Boeing Company
- Unigold International
- Unisoft
- Univac Precision Engineering
- Wong Hing Long Technologies
- Yodu Wanco

Research Partners

- Bremen University (Germany)
- Huazhong University of Science and Technology (China)
- Ibaraki University (Japan)
- Institute of High Performance Computing (Singapore)
- Institute of Materials Research and Engineering (Singapore)
- Integrated Manufacturing Technologies Institute, NRC (Canada)
- Korea Institute of Machinery and Materials (Korea)
- Nanyang Technological University (Singapore)
- National University of Singapore (Singapore)
- Setsunan University (Japan)
- The Ohio State University (USA)
- The Queensland University (Australia)
- The University of Calgary (Canada)
- The University of Manchester (UK)
- Tohoku University (Japan)
- University of New South Wales (Australia)

