



**NATIONAL TECHNICAL
UNIVERSITY OF ATHENS**



**LABORATORY OF
MANUFACTURING
TECHNOLOGY**

Director: Academician Professor Dr-Ing. A.G. MAMALIS



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The Laboratory of Manufacturing Technology of the National Technical University of Athens, located at the University Campus in Zografou/Athens, in its present form has been established in 1982 by Academician Professor Dr.-Ing. A.G. Mamalis. It covers a working area of about 3.200 m², extended to 3 floors. A great deal of education, research and industrial experience has been accumulated within it with respect to the deformation mechanics and the behaviour of advanced materials both during their manufacture and under service loading.



Professor A.G. Mamalis is the Head of the Manufacturing Technology Division of NTUA since 1982. He has vast research, academic and industrial experience in the field of Mechanics and Manufacturing Technology. Currently, Prof. Mamalis and his team (comprised of about 20 research and technical staff) are involved in a number of industrial projects related to Deformation mechanics, Applications of FEM in manufacturing processing, Crashworthiness of vehicles, Advanced manufacturing of advanced composites, ceramics and high-T_c superconducting materials, Flexible manufacturing/expert systems.

The published work of Professor A.G. Mamalis is related to

- Mechanics
- Manufacturing Technology
- Structural Plasticity
- Materials Technology

and covers the theoretical, experimental and practical aspects of

- Deformation mechanics, Plasticity, Impact, Fracture, Numerical modelling analysis and simulation

- Manufacturing processes (Metal forming, Metal removal processing, Powder processing, Welding/Cladding, High energy rate forming)
- Materials technology (Metals, Polymers, Ceramics, Composites, Coated materials, High-T_c superconductors)
- Precision and Ultraprecision engineering, Nanotechnology
- Surface integrity, Friction/Lubrication
- Structural plasticity, Crashworthiness of vehicles, Energy absorbing devices
- Manufacturing systems, Advanced Manufacturing, Simulation/Modelling, FMS, Automation, Robotics, CAM/CIM, Expert systems.

It consists of (1973- today)

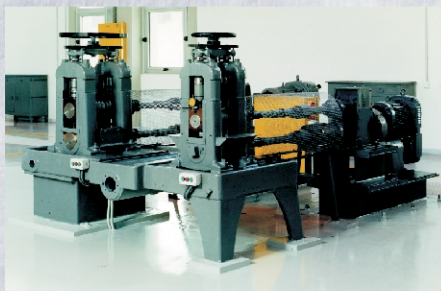
- 23 Books and Monographs
- 10 Textbooks
- 1 Ph.D Thesis
- 350 Papers in refereed Journals and Conference Proceedings

From theoretical and experimental research activities point of view, the Laboratory of Manufacturing Technology participates into a great number of research projects (European, national and under bilateral agreements) mainly with industrial international and national cooperation, qualified in the following areas of research:

- Theoretical aspects of plasticity and stress wave propagation, numerical modelling and simulation of processing and constitutive behaviour of materials.
- Manufacturing processes: rolling, forging, extrusion, sheet metal forming, metal removal processing, explosive cladding, casting.
- Precision and Ultraprecision engineering, Nanotechnology
- Powder processing (static and dynamic) of metals, ceramics and advanced high-T_c superconducting materials.
- Structural plasticity pertaining to the crashworthy deformation of thin-wall structures of metals, polymers, composites and bi-materials for application in the automotive, rail and aircraft industry.
- **Advanced Manufacturing**: CAD/CAM/FMS/CIM/Robotics/Expert Systems/Simulation.

The Laboratory of Manufacturing Technology of NTUA is well equipped with fully automated machines and instrumentation related to the various aspects of manufacturing:

- **Forming**



- Two 2-high rolling mills for flat and profile rolling operations.
- A Schuler vertical mechanical press 630 kN for sheet metal forming.
- A Schuler horizontal high speed mechanical press 1500 kN for dynamic forging/upsetting and coining operations.
- A SMG vertical hydraulic press 1000 kN for forging, extrusion, sheet metal forming, powder processing and crash testing.
- A drop-hammer with 6 m drop-height and 100 kg falling mass, providing strain-rates up to 100 s⁻¹, for dynamic compression, forging, powder processing and crash testing.



- A ball drop forming rig for contour forming.

Note that, part of the above equipment, served by a V-arm robot and automatically controlled, constitutes a Flexible Manufacturing Cell for Forming.



- **High energy rate forming (HERF)**

- An electromagnetic forming machine of 30 kJ discharge capacity, for forming tubular components and sheets and for dynamic powder compaction of metals and advanced ceramics.
- An explosive chamber of 0.5 kg TNT charge capacity for explosive bulk and sheet forming, explosive welding/cladding and explosive powder compaction of metals and advanced ceramics.

- **Metal removal processing**



- Conventional machine tools (7 lathes, 3 drilling, 1 radial, 2 milling, 2 planing, 3 grinding machines and auxiliary equipment) constituting a complete Machine Tool Workshop.

- An OKUMA CNC precision turning center, operating in air-conditioning environment, mainly used for precision and ultraprecision manufacturing.
- An OKUMA Machining Center (5-axis) for various CNC metal removal operations.

Note that, these two Centers, equipped with various software associated with FMS, CIM and Expert Systems, constitute an Integrated Manufacturing Cell for Metal Removal Processing.

- **Surface engineering/Coating**



- A shot peening / sand blasting machine for contour forming and surface treatment.
- An AGIE fixed tool electro-discharge machine (EDM).
- A METCO plasma-spray installation, fully automated, for metal and ceramic coatings.

- **Casting/Heat treatment/Injection moulding**

- Complete casting installation for sand and metallurgical mould castings.
- Two electrical furnaces for heat treatment operations.
- A Johnson extruder for injection moulding of polymeric materials.

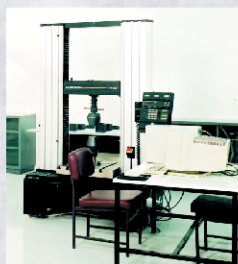
- **Welding**



- Complete installation consisting of oxy-acetylene, arc-welding, MIG/MAG, TIG welding machines and auxiliary equipment for conventional welding operating.

- **Materials testing and characterisation**
Mechanical testing

- An Instron universal testing machine 100kN, fully automated, for uniaxial tension/compression and bending testing
- A hydraulic bulge test rig for biaxial testing.



- A mechanical press 80 kN for flexural fatigue testing
- A residual stress rig for residual stress field measurements
- Two Taylor-Hobson surface roughness measuring rigs.

Metallography/Microstructure



- Complete image analysis system.
- Three optical microscopes (Leica, Unimet).
- Two microhardness testers (Leitz, Instron/Wolpert).
- A Wolpert hardness tester.
- Two Struers polishing machines for metallographing preparations.
- A Struer discotom for precision specimen cutting.

- **Computer Center**



Very big and modern facilities in hardware (UNIX, PC Lab etc.) and software (LS-DYNA, MARC, ANSYS, NASTRAN, EUCLID, PRO-ENGINEER, AUTOCAD etc.) for numerical simulation, design and automatic control of the machine tools.

- **Teaching Facilities**



The Laboratory is equipped with Library and Lecturing Halls. Every Academic Year provides 35 obligatory Experimental Laboratory Courses, covering the whole area of Manufacturing and Materials Technology, for all undergraduate students of the School of Mechanical Engineering (from the 1st to the 9th Semester).

