PRESENTATION

The Laboratory of Robotics and Mechatronics (LARM) was founded in 1990 at the School of Engineering of the University of Cassino. The aim of LARM is to develop experience, teaching, and research in the fields of Automation, Robotics, and Mechatronics with main focus on aspects of Mechanical Engineering. The activities of LARM are directed and available for collaborations in industrial and professional activity with the purpose to study, to plan, and to improve mechanical systems, with traditional and innovative designs. The development of these on subjects and prototypes for innovation is orientated to form engineers, who will be capable to solve new problems but still with interest on traditional techniques of Mechanical Engineering.

RESEARCH ACTIVITY

Kinematics of serial and parallel manipulators

The Kinematics of manipulators is investigated in term of Workspace, Inverse Kinematics and Path Planning. Both analysis and synthesis algorithms are studied and developed. Results of theoretical studies and numerical applications are used and checked by building prototypes of new devices. 

**Built prototype:** CaPaMan (Cassino Parallel Manipulator) in three design architectures, Low-cost anthropomorphic arm, CaTraSys (Cassino Tracking System), CaLoWi (Cassino Low-cost Wire Parallel Manipulator), LARM clutched arm.

**Performances of multi-body systems**

Several models for stiffness and dynamic performance analysis for multi-body robotic systems are developed with the aim to design and improve the operation of existing systems.

**Built prototype:** Milli-CaTraSys for stiffness evaluation

Mechanics and design of biped walking robots

Human walking has been mimicked by developing a mechanical design for a biped walking robot. Walking systems are studied in term of Kinematics, Dynamics and Control through several mechanical systems.

**Built prototype:** EP-WaR (Electropneumatic Walking Robot), Cassino Biped Mechanism, Cassino Rickshaw robot, Cassino hybrid walking robot, Cassino Hexapod robot.

Mechanics of manipulation and industrial robotizations

Mechanical aspects and manipulation programming of industrial robotizations are studied with the aim to enhance existing industrial applications and to develop new manufacturing solutions. The Mechanics of robotized manipulations is investigated also with experimental simulations and development of suitable devices for end-effectors and test systems.

**Mechatronics**

Mechatronic systems are studied and designed with the aim to enhance integration of electrical, electronic, pneumatic and mechanical systems. Operation and behavior of mechatronic systems and prototypes are investigated also by means of experimental tests.

**Mechanics and design of mechanical grippers**

The Mechanics of Grasp is studied by referring to mechanical grippers and articulated fingers. The mechanical design of gripping mechanisms is investigated for analysis and synthesis purposes by using built prototypes. Low-cost solutions are investigated for user-oriented applications.

**Built prototype:** Grippers, LARM Hand.

Analysis and design of mechanical systems for automation

Mechanical systems are studied with the aim to develop new solutions, optimum designs and operation improvements. Mechanical aspects are investigated through suitable modeling and formulation that are used for numerical simulations and design algorithms. Numerical simulations are computed for dynamic behaviors and characterizations. The characterization of the systems can be validated by experimental tests.

**Mechanics and design of mechanical transmissions**

The experimental analysis of cam is developed by using a suitable test-bed. Kinematic and Dynamic analysis is developed in order to validate both numerical design procedures and designed cam profiles. A test-bed for brake system has been designed with the aim to check its efficiency and performances. The test-bed is designed as composed of modular by using low-cost and commercial sensors.

**Built prototype:** Test-bed for gear and cam systems, test-bed for brake systems.

History of Mechanism and Machine Science

Historical evolutions of MMS are investigated in terms of theory formulation, machine designs and mechanisms, and inventor developments with the aim also to use past experiences in technical teaching and research today.
TEACHING ACTIVITY
Curriculum in Mechanical Engineering (Laurea):
Course: Fundamentals of Mechanics of Machinery
Practice Course: Laboratory of Mechanisms
Practice Course: Simulation of System Operation
Practice Course: History of Mechanisms
Courses for Automation and Production (Master):
Course: Robots and Automatic systems
Course: Design of Mechanisms
Curriculum in Electrical Engineering (Master):
Course: Elements of Mechanics of Machinery

APPLIED RESEARCH
LARM activity is also available and carried out for applied research with and without research contracts with enterprises with the aim both to apply research results and to solve problems in engineering practice in industrial and non-industrial applications. In particular, the study can be focused in new designs of robots and machinery, analysis for problem solutions in manufacturing processes and in robotized manipulations, functionality enhancement of existing mechanical systems. LARM is available for joint projects within local, national, and international frames, particularly in European framework.

COLLABORATIONS
LARM invites scholars and students for periods of study and collaborations in the subjects of common interest with academic and non-academic institutions. Past activity has been carried out within SOCRATES program and within, but not only, signed international agreements for bilateral projects with several extra-European universities. Theses for Bachelor, Master and PhD students are developed within LARM activities, both in own projects and in co-tutorship with other institutions. PhD candidates are welcomed also for double degree PhD programs in collaboration with other Universities.

PEOPLE AT LARM
LARM activity is carried out by researchers and students from Bachelor, Master, and PhD programs under the supervision and guide of the staff members. Staff members: Dr. Giuseppe Carbone and prof. Marco Ceccarelli.