Research Activity

Andrea Manuello Bertetto has carried out research in various fields of Applied Mechanics.
The research topics concern the Applied Mechanics, Dynamics of Mechanical Systems, the Tribology, the Fluids, Automation in Fluid, Industrial Automation, Devices and Systems Biomechanical. The work is attested by more than 100 publications including 70 international.
Andrea Manuello Bertetto participated in research funded by public authorities (Ministry of Research, Piedmont Region, Region of Sardinia) and in contract research industry.
The research of Andrea Manuello Bertetto at the Politecnico di Torino continued even after the service outlet at the University of Cagliari working on issues related to the Space, the Trichology, energy savings in mechanical systems and components. In particular, Andrea Manuello Bertetto helped in European Projects (program Kristall - Head: prof. Guido Belforte) and Regional Projects (Call 2004 n. E51, scientific director prof. P. Maggiore).

Are reported, with a brief description of the main research topics of scientific Andrea Manuello Bertetto.

• Components and mechanical systems
Study of mechanical devices for the distribution of natural gas
In order to model the dynamic behavior of cabins industrial processing of natural gas, for the purpose of evaluation of the error made in the flow measurement, have been studied both components of pressure regulation of both flow measurement. The study required the dynamic modeling of the components and the entire distribution line and, also, the development of experimental methodologies targeted identification of the model parameters and validation of the dynamic performance of the various components and the entire cabin as a whole .
It is also implemented the model of the behavior of the entire cabin distribution realizing a numerical code for the simulation of the dynamics of the targeted system, in particular, to the evaluation of the error of measurement of flow regime and during transients.
Particular attention was paid to the experimental characterization of the pressure regulators and gauges industrial turbine.
The simulation code has been validated experimentally therefore, even in conditions of fast transients.
Modeling of pneumatic
It is conducted the study of the behavior of plants tires of large linear development, which does not permit to neglect propagation phenomena inside the ducts, in particular under conditions of fast transients. The study led to the definition of a code that is configured in a "user friendly" because, of the four modules of which it is composed, those relating to the user interface provide for the possibility of an interaction completely entrusted to the "mouse".
Validations carried out show that the simulation results are reliable, because in good agreement with the experimental results obtained from tests carried out specifically.

• Pneumatic components innovative
Pneumatic cylinder electromagnetic coupling reversible
It has been studied, developed and characterized a pneumatic cylinder without a piston rod with electromagnetic coupling between plunger and slide connected to the load. Such a cylinder, suitable for linear transport lines, is capable of handling different loads, on the same line, with a single plunger, since the coupling between the plunger and the different loads is of the electromagnetic type and then of the reversible type.
Consistent with the bores trade considered, it is maximized transmissible load of the electromagnetic, which presents the lines of force of the field orthogonal to the direction of the force which tends to decouple plunger and slide loaded.
The behavior of such a cylinder has developed an experimental formula able to predict, for cylinders geometrically similar, the coupling force. The cylinder is made has been tried in different working conditions.

Interfaces
Has developed an interface electropneumatic based on the transition from laminar to turbulent flow of a tire in amplifiers controlled by acoustic signals identifying ranges of variation of acoustic frequencies favorable as a function of particular geometries of the elements.

• Robotics
Grippers with sensors in self-adaptive force
For the realization of components targeted use of robots in the agricultural field and, in particular, for the collection of products of agriculture, it is designed, manufactured and characterized a hand autoadaptive, sensorized in force, for the gripping of objects of the form also elongated, who are in position off-center and still generic in the working space of the hand. In order to obtain a secure grip and such as not to damage the delicate object, the hand is equipped with force sensors robust and low-cost, suitable to operate in agricultural environment unstructured, where bumps are possible, and these asperities, ground water temperature changes.

For the realization of the control of the force exerted by the fingers of elements operated by pneumatic actuators and for the gripping of objects also delicate, was conducted a theoretical study of an actuator system - valves - force sensor - control. Later he conducted a series of tests to verify the static and dynamic performance of the system. Finally has been studied the application of the control studied to a hand for gripping delicate objects.
Have also been designed and developed hands on the secondment of flowers on the field in order to make profitable cultivation of saffron burdened with heavy costs resulting from long and complex process of collecting. These hands have been implemented and successfully tested at the operating companies in the agri-food sector in the Middle Campidano in Sardinia

Rotary actuators for robotics
For the detailed knowledge of the behavior of air motors palette, in anticipation of their useful modeling the implementation of remote manipulators, applied a technique of telemetric sensing chambers of vane motors for the evaluation of the instantaneous pressure in the storage , as a function of the position and angular velocity of the rotor, also for high angular velocities.
The trends identified were interpreted both in the case of commercial engines and motors derived from these, where changes have been made in order to identify the causes of complex patterns of instantaneous pressure in vain. In this way were isolated influential factors, geometrical and operating, conducting parametric analyzes targeted.

Actuators Flexible multi-degree of freedom
For applications in unstructured environment and that do not require high positioning accuracy, it may be convenient to use special actuators such as pneumatic actuators flexible.
E 'was developed a research that has led to the realization of different prototypes of flexible actuators, with elastomer body with several chambers, to be used as positioners to various degrees of freedom. The actuator has been characterized experimentally. The tests conducted have made it possible to assess the working space and to monitor the quality of the construction of the model created with particular attention to the symmetry of the flexible element and the viscoelastic behavior.
E 'was proposed a mathematical model of the actuator direct that, depending on the pressure in the rooms, is used to determine the position of the end-effector; the experimental tests conducted have made it possible to validate the model. The flexible actuators studied and have made it possible to realize a mobile robot type biomorph that uses two flexible actuators to two rooms.

Muscle actuators in fluid
Has developed a new type of actuator muscle, called muscle fibers straight, with optimized performance in force in relation to the mass of the actuator. Illustrating the structure of the prototype, they are performance measured experimentally. The type of actuator studied was therefore defined a mathematical model that can predict the performance depending on the geometry and material properties. The mathematical model has been validated on the basis of experimental evidence.

Concept, design and implementation of environment space rover
Has developed a new type of lunar rover for handling loads in lunar environment in anticipation of a use for the construction of lunar bases planned for the next five years. The study and development was conducted as a collaboration with the Department of Aerospace Engineering at the Politecnico di Torino (head prof. Paolo Maggiore).

• Fluids
Vortex Valves
For the study of industrial applications intrinsically safe, for the development of vortex valves to be used as safety valves, able to allow the passage of an instantaneous flow in emergency conditions, it is conducted a study articulated both experimental and analytical elements fluidic vortex.
In these applications it is of fundamental importance the study of the reduction of the ratio between the flow control and the flow rate of power supply conditions blocked.
A test bench was specially designed; the analysis was carried out starting from geometries of conventional valves to switch to more sophisticated models, in order to minimize the ratio between the flow of control and power supply. For this purpose, particular attention has been devoted to the influence of the geometry of the chamber vorticity, the number and geometry of the inlet and outlet. The experimental analysis has been accompanied by a survey-parametric dimensionless results that allows you to give validity to the general experimental methodology adopted and the results it has achieved.
The study carried out allows a good optimization of the geometry of the valve and allows, according to the knowledge of the geometric parameters dimensionless identified as excellent, sizing the valve for specific applications.

Fluid sensors
For industrial applications it is necessary to detect the presence of objects and to measure the distance without contact, we have studied the performance of fluid sensors capable of operating in a hostile environment and surveys were

conducted experimental and numerical evaluations of the response times of systems sensorization equipped with such sensors. This led to the proposal and implementation of modifications to traditional fluid sensors so as to make them suitable for use in hostile microclimate, in particular in the presence, in addition to dust, noise and vibration, high temperatures and large temperature fluctuations.
For applications where it is necessary to measure with high precision of relatively large distances, it is designed realized and characterized a fluid sensor in backpressure of low cost and high precision by maximizing the distance field that is very high for sensors with this principle of operation.
Of such a sensor is also realized and implemented a mathematical model.

Fluidic amplifiers
E 'was conducted a study of fluidic proportional amplifiers with high gain for applications that require a high degree of safety thinking of applications as an interface and electro optofluidica.

Fluidic vortex separators
A study of vortex separators, dedicated to special applications for agri-food products with high added value, it inserts them in research for the automation and mechanization of processes for the collection and processing of products with high added value Slow Food chain.
This activity, supported by finziamenti of regional and national authorities, with the aim of achieving a competitive phase of the husking of the spice saffron, raising the fund to be prohibitively expensive and time are incompatible with the needs of the market.

Pneumatic seals
To respond to the need to have seals at the same time effective from the point of view of the sealing and low friction, to reduce the forces resistant and contain the energy losses, it is conducted a series of studies, both experimental and analytical, of gaskets of different geometry and operating in different working conditions.
In order to increase both the safety and the reliability of sealing systems has been developed an experimental and numerical, aimed at the study of the problems of wear and friction forces in seals for pneumatic cylinders.
For this purpose, have been designed and manufactured special test benches that allow to evaluate the durability of seals and to monitor over time the state of efficiency, under varying operating conditions of operation.
In order to minimize the frictional forces to hold the energy losses, it is conducted a series of studies related to the contact of the sliding surfaces of seals operating in different working conditions. Through the development of finite element numerical models and experimental tests it was possible to determine the contact pressure and the friction force between the sealing element and the surface creeping; also was evaluated geometry and extent of the area of the surface of contact under varying operating conditions and operation of the gasket. The comparison between the results obtained with the numerical models and experimental measurements confirmed the validity of the methodology used conferring reliability to the numerical results in the various operating conditions and the working of the seals studied.
E 'was designed and built a bench for experimental analysis photoelastic to reflection, in order to determine the range of tension and deformation on the real elastomer seal. The tests were conducted on different types of gaskets, housed inside the test chamber, reproducing the real operating conditions of the seals concerned. The experimental results have allowed us to validate finite element models through which it is possible to proceed to the optimization of the section of the seals concerned, in order to reduce the frictional forces.

• Devices and biomechanical systems
Mechanical aortic valve opening
In order to analyze the mechanical opening of aortic valves and to evaluate the mechanical efficiency of bioprosthesis also innovative, have been carried out numerical analysis of the behavior of these components. The study is considered the particular mechanical properties of tissues that appear to be anisotropic, inhomogeneous and non-linear. To this end it is a campaign of experimental tests designed to mechanically characterize the biological material. They are made of special experimental equipment for material characterization and experimental validation of numerical models of the biostructure considered.

Aids for the disabled
Were studied mechanical devices capable of providing help to the mobility of disabled. These systems use drives of type and electric and pneumatic.
It is designed and manufactured equipment which assist disabled totally inert, able to allow the movement in conditions of safety and assistance in order to achieve the change of posture from lying down to erect or sitting position. These tools are also useful for passive exercise.
In order to realize the movement of disabled inert to the lower limbs and to realize passive exercise and rehabilitation has been designed and realized with a guardian active exoskeleton, for a correct execution of the step.

• The scientific activity is documented by about two hundred national and international publications.