# Interactive Workshop and Technology Appreciation Seminar on ``Mechatronics Applications''

An one day program of *Interactive Workshop and Technology Appreciation Seminar on ``Mechatronics Applications''* was organized on October 20, 2001 (Saturday) in the newly built Mechatrnoics Laboratory of the Mechanical Engineering Department at IIT Delhi, and the ME Committee Room, respectively. The new laboratory has been set up to support existing teaching in Mechatronics, enhance research in the area of Automation and Robotics, and provide training/consultancy to the industries. Thus, the objective of the workshop and the seminar was to share the experiences of different colleagues from industries and IIT Delhi in the area of Mechatronics to encourage indigenous automation activities for higher productivity, quality and profitability. Dr. S.K. Saha, an Associate Professor in Dept. of Mech. Eng. and Faculty In-charge of the Mechatronics Laboratory, has coordinated the day's programs.

In the morning 4-hours session of **Interactive Workshop,** participants in a group of two have seen each demonstration first before they themselves programmed and ran the systems. They spent about 30 minutes in each of the six major facilities (out of about 15) made available for the hands on experience.

One participant running the Intelligent Conveyor System with
Fiber Optic Sensor
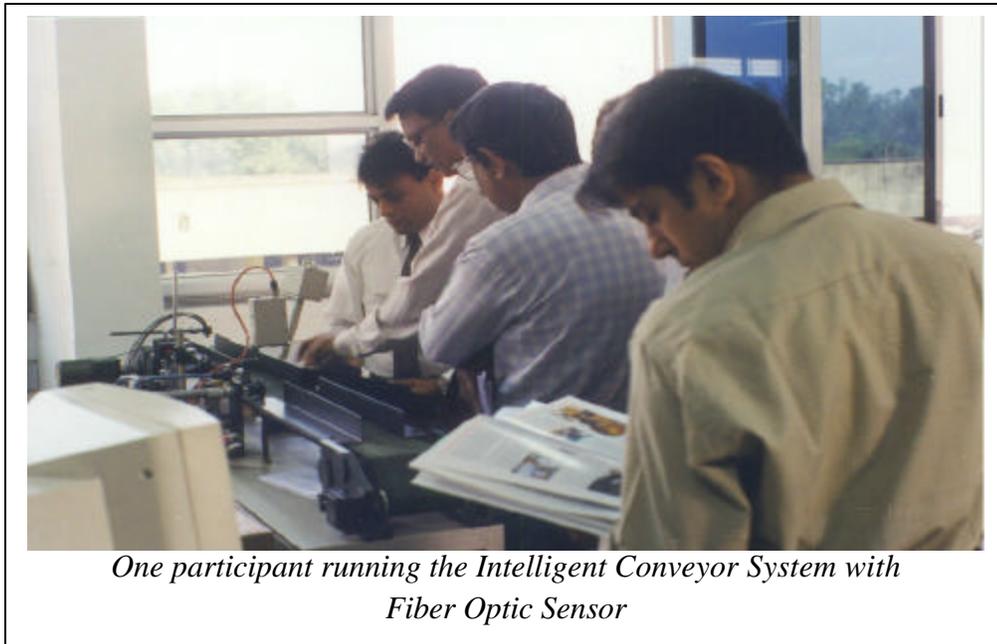
1. <u>Intelligent Conveyor System</u>: A PLC controlled conveyor system can inspect, e.g., distinguish the colours of two products, and accordingly separate them by allowing one on the conveyor and pushing the other by a pneumatic actuator.
2. <u>CNC XY Positioning System</u>: This is to simulate a CNC milling table. Results from the mathematical model using MATLAB are compared with real experiments.
3. <u>MA300 Robot</u>: A 5-axis teaching robot is demonstrated for its path planning.

4. <u>RTX Robot</u>: The 6-axis robot is demonstrated to solve Tower of Hanoy problem
5. <u>TURTLE Mobile Robot</u>: A mobile platform useful for material transfer in a shop floor is shown to move in a circular path and its accuracy was checked.
6. <u>Virtual Robotics Laboratory (Using ADAMS 11.0)</u>: Automatic Dynamic Analysis of Mechanical Systems (ADAMS), a commercial software for any mechanical system simulation was used to develop a set of basic robots for teaching purposes.

The hands on experience allowed the participants to feel about the level of sophistication in the associated technologies. Even though the limit of participants was kept 10 to have closer interactions, it was relaxed to 12 by adding the 6th set-up. The workshop was attended by industries (BHEL, Bhopal; DENSO India Ltd., Noida), academic institutions (NSIT, New Delhi; ITMMEC, IIT Delhi), and training centers (CRISP, Bhopal).

In the afternoon, during the **Technology Appreciation Seminar** (TAS), four technical presentations were made after Dr. Saha has briefly introduced the subject.

1. <u>Automatic Glass Transmission Measurement by Dr. S. Mukherjee, Associate Professor, ME Dept., IIT Delhi</u>

With the increase in illegal activities inside cars and other vehicles, which were facilitated by the dark films on the window, the court wanted the Delhi Police to measure the transparency of the windows based on which the rules could be framed. The project was given to the TRIPP Lab. of IIT Delhi. The purpose of the project was to develop an instrument that could measure the transparency of glass. Dr. Mukherjee has applied for a patent for this instrument, where the micro-controller (single line alphanumeric display) was employed to continuously control the current through the filament. A 12V battery powered the micro-controller. To stabilize the out put of the photodiode magnets were used. The instrument has the following features: Portable; Low Weight and hand held; Ambient temperature maintenance by cooling; Energy consumption of 20 watts. The cost of the instrument is about Rs. 12,000/-.

2. <u>*Automation in Manufacturing Process of Rack-bar* by Mr. Manoj Sharma, Manager, Sona Koyo Steering Systems (P) Ltd.</u>

A case study was presented in which automation of a production line is explained. Initially, the line involved 7 operations, namely, Loading of a part on Centerless Grinding m/c; Unloading the part from it; Loading the part on Thread Rolling m/c; Thread Rolling in the m/c; Transfer the part from the Rolling m/c to Flat Broaching m/c; Loading of the part on Flat Broaching m/c; Unloading the part from it. The results of the automation are: Reduction in manpower from 3 to 2; Human error eliminated; and No change in cycle time (55 sec). The cost of the total set-up was about 3.5 lakhs (including the PLC) and the buy back period was about 6 months. One of the main considerations while designing this system was to maximize the use of gravity. POKE-YOKE (Full-proofing) methodology was also incorporated by introducing the proximity sensors to interlock the process. The entire line would stop if any of the operations encountered a problem. For this, the sensors were installed at strategic locations of the production line. All the parts used were

Presentation of Mr. Sharma of Sona Koyo Steering Systems (P) Ltd. during the Technology Appreciation Seminar

designed and manufactured in-house. Only the PLC (SIEMENS) controller and pneumatic valves (FIESTO) were purchased. Video of the automation was also shown.

3. *SAMTEL Corporate Division: A Perspective* by Mr. N.K. Sehgal, Vice-president, Coporate Projects, SAMTEL

The company started in 1973 by an IITian. The group presently has 6 companies with over 4500 employees. It collaborates with Mitsubishi, Japan, for the CVT manufacturing. Mr. Sehgal pointed out the difficulties in different modes of collaborations. For example, in Joint Ventures compatibility between the two companies is an issue, whereas in Technology Transfer the company supplying the technology keeps certain key information and technology secret from the partner. This stifles the development and flexibility from the dependent's point of view. In case of in-house development there can also be two modes. Having your own R&D entails a lot of cost. The department becomes too specialized in one kind of technology. Often certain competencies required for the development are not available at the time of inception of the project. Other mode is to outsource the R&D services from the research and other academic institutes like IITs and IISc. Benefit is that the technology transfer is complete. Utilization of the services of the best researchers in the country is possible at a reasonable cost. Also, the resources of these organizations can be utilized indirectly for the company. SAMTEL's focus is on in-house development and utilization, primarily on Intelligent m/c, Data tracking system, Vision System, and Motion Control Applications. The company also sold a 7-axis plasma cutting m/c to Mahindra and the Button sealing m/c to SAMCOR Glass Ltd. It has developed about 30 automations, and rest are bought from FANUC.

4. *Design of Stepper Motors for Space Applications* by Dr. K.R. Rajagopal, Assistant Professor, EE Dept., IIT Delhi

A computer aided design and development of an optimized module type 200 step Hybrid Stepper Motor, which is used as the drive motor of solar array of the INSAT in the geo-stationary orbit, was presented. The motor is of size 23 having coil redundancy

and the step angle is 1.8^o. It is designed with an optimized tooth-geometry and module geometry, using FEA technique. This makes it very compact. The motor delivers holding torque of 0.5 Nm against a varying supply voltage of 28-42V DC, and in an operating temperature range of -55 to $+75^oC$ by taking advantage of the torque saturation phenomena available in hybrid stepper motor. Results of the 2-D and 3-D FEA on tooth and module geometry, respectively, are also discussed. Apart form the design procedure, relevant details regarding the fabrication and testing were also provided. The test results of the developed motor match fairly well with the design objectives.

The session was chaired by the Head of the ME Dept., Prof. K. Gupta, and the seminar was attended by over 30 people from industries (DENSO, BHEL, EEL, SONA, SAMTEL), academic institutes (NSIT, ITMMEC, DMS & EE Dept. of IIT Delhi), and a training institute (CRISP).