THE CONNECTION MACHINE AT THE UNIVERSITY OF PARMA

GIOVANNI ADORNI and GIANNI CONTE

Dipartimento di Ingegneria dell'Informazione
University of Parma
43100, Parma, Italy

This note presents the site in Parma where the Connection Machine CM-2 is located, the reasons for its acquisition in the framework of the EUREKA PROMETHEUS project, and the list of the current research activities carried on using the Connection Machine.

1. The School of Engineering of the University of Parma

The School of Engineering of the University of Parma was established in 1987. Despite its brief existence is part of one of the oldest Italian universities, established more than one thousand years ago. The School of Engineering is organized to offer degree courses in: Civil Engineering, Electronic Engineering, Mechanical Engineering. The faculty staff is presently composed of: 28 full professors, 33 associate professors, 22 assistant professor. The research structure of the School is based on the following departments: Department of Civil Engineering, Department of Information Technology, Department of Industrial Engineering; each accommodating the specific research and teaching activities.

The buildings hosting the School are located within the new technical university campus on the south of Parma, where there are also the institutes and departments of the faculty of Sciences, the Computing Center of the University, the "Santa Elisabetta" Congress Center, and other facilities of the University. There is also (under construction) the Institute of Special Materials for the Electronics (MASPEC) of the National Research Council (CNR). The new School of Engineering, besides responding to the ever-increasing demand for engineers from the country in general and from the productive industries in the territory around the University of Parma in particular, is becoming a useful reference point for the professional and industrial activities in technological sectors which are of vital importance for the development of the area in which the School is located.

2. The Department of Information Technology

The Department of Information Technology has the aim of developing teaching and

research activities and of acting as a reference center in the three main areas of Computer Engineering (distributed and parallel systems, VLSI architecture, computer performance evaluation, computer vision, robot planning, and knowledge based systems), Electronic Engineering (microelectronics, instrumentation, and power systems), and Telecommunication Engineering (optical communications, digital radio links, and radiomobile systems).

Placing these areas together in the same department allows a substantial interaction among researchers, a better use of resources, the development of broad-scope research and the creation of a reference point for the scientific and economic environment. The department covers also the teaching activities in Information Engineering (undergraduate, graduate and Ph.D. courses). In order to make the best possible use of the resources available, the activities of the computer science group have been concentrated on a small number of strategic sectors; one of that, PROMETHEUS, is described in the next section.

3. The Connection Machine and the PROMETHEUS Project

The EUREKA Projects are to remove structural obstacles and improve the competitive strength of Europe on the world market. PROMETHEUS (PROgraM for a European Traffic with Highest Efficiency and Unprecedented Safety) is a such project. In this project, fourteen of Europe's leading car manufacturers are to join with approximately forty research institutes to make the traffic of Europe safer, more efficient and more economical. In the long term, PROMETHEUS is aimed at reducing traffic accidents to a minimum and contributing significantly to an increase in the efficiency and utilization of resources in road traffic by creating new information and control systems. Use will be made of foreseeable technological advances in the fields of microelectronics, sensor engineering, telecommunications, information processing, and artificial intelligence. PROMETHEUS project is divided into seven areas. The car industry is to handle three of these. The other four consist of basic research projects.

The three car industry projects are: PRO-CAR, PRO-NET, and PRO-ROAD. PRO-CAR concerns the technological development of the systems to be found in the vehicles, to assist and relieve the driver in the performance of his driving tasks. PRO-NET has the task of developing communications between vehicles so as to assist the driver's control over other road users and thereby promote accident-free traffic. PRO-ROAD concerns information systems for communication between the road and the on-board computer.

The basic research projects are: PRO-ART, PRO-CHIP, PRO-COM and PRO-GEN. PRO-ART is aimed at clarifying the need for and the principles of the artificial intelligence to be used in the system. PRO-CHIP which has the task of developing the microelectronics components required to build systems with the necessary capacity. PRO-COM is devoted to the development of the architecture and the general protocols necessary to optimize the communication of data between vehicles, road and environment, and to harmonize the interface components. PRO-GEN is

devoted to the study and the analysis of all the scenarios - all the traffic situations which can occur. The purpose is to study the proposed systems and evaluate how they can be adapted and incorporated in traffic.

The PROMETHEUS project, of 8 years' duration, was set in motion in 1987. For basic research activities, it is supported in Italy by the CNR under the aegis of the Progetto Finalizzato Trasporti II, directed by Prof. Lucio Bianco.

The coordinators of the basic research projects (among which there are the authors of this note), together with the Director of the Progetto Finalizzato Trasporti II, and the Director of MASPEC Dr. Lucio Zanotti, by purchasing the CM-2 Connection Machine, have equipped the groups working on the project with an avant garde installation ideal for addressing the scientific problems of this project. More specifically, the CM-2 will be used in connection with the study project and the testing of algorithms in real time in sectors of mono-dimensional signal processing, for the recognition of images, for the comprehension of written and spoken languages, for multiagent planning (themes involving the PRO-ART project), for the simulation of complex architectures and for CAD for large-scale integrated circuits (themes involving the PRO-CHIP project), for the simulation of data exchange on radio networks (a theme involving the PRO-COM project), and for the simulation and analysis of complex traffic flows (a theme involving the PRO-GEN project).

3.1. *CM-2 configuration*

The CM-2 of the Parma site has the following configuration:

- 8K processors with floating-point unit.
- 64K bytes per processor (512 Mbytes).
- 2 sequencers controlling 4K (o 8K) processors each.
- 1 frame buffer.

The front end is a SUN 4/260 with 32 Mbytes memory and 1.5 GB disk. The front-end is connected to the CNR national research network (GARR) and can be remotely accessed by the universities and CNR research groups interested to work on a massively parallel machine.

3.2. *List of research groups working on the CM-2*

In this section are listed the activities that are carried on using the CM-2 at the Technical Campus of the University of Parma. For more detailed information please contact the authors that will be pleased to give you more specific details.

3.2.1 Prometheus (PRO-ART)

- Computer vision and cellular automata, University of Parma.
- Artificial intelligence, learning algorithms, Polytechnic of Milano.
- Image analysis and computer vision, I.E.N. Galileo Ferraris - Torino, University of Genova, and University of Trento.
- Neural networks and computer vision, University of Palermo.

- Parallel logic programming, University of Genova.

3.2.2 Prometheus (PRO-CHIP)

- Computer vision and VLSI architecture, University of Parma.
- Parallel signal processing and VLSI architecture for artificial neural networks, Polytechnic of Torino.

3.2.3 Physics

- Parallel computation, computational physics, image reconstruction and neural networks, University of Bologna.
- Gauge theory on lattice, Lattice spin models, Montecarlo simulation on lattice, University of Parma.
- Geophysics, Osservatorio Geofisico Sperimentale of Trieste.
- Cellular automata, statistical mechanics, University of Parma.

3.2.4 Microelectronics

- Microelectronics and CAD for VLSI, University of Roma.

3.2.5 Computer Science

- Parallel computing and complexity of algorithms, University of Pisa.
- Parallel architectures and CAD for VLSI, Polytechnic of Torino.
- Natural language processing, University of Parma.
- Computer vision and pyramidal architecture, University of Pavia.
- Computer vision and neural networks, University of Firenze.
- Computer vision and machine learning, University of Bologna.
- Image interpretation, University of Milano.
- Ray-tracing and geometric modeling, CNR-Milano, and University of Parma.
- Neural networks and speech understanding, University of Firenze.
- Performance analysis of algorithms for speech and vision, I.R.S.T.- Trento.
- Neural networks, University of Parma.
- Neural networks, genetic algorithms and artificial life, CNR - Roma.
- Computational geometry and geometric modeling, CNR - Genova.

3.2.6 Ecology, biology

- Theoretical ecology and dynamics of population, University of Parma.
- Medical imaging, Ospedale San Raffaele of Milano.

Acknowledgements