A CONTROL MECHANISM OF A LISP-BASED DATA-DRIVEN MACHINE

Toshitsugu YUBA, Yoshinori YAMAGUCHI and Toshio SHIMADA
Electrotechnical Laboratory, Sakuramura, Niiharigun, Ibaraki 305, Japan

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1. Introduction

We are doing research on and development of a Lisp-based high level language machine with data-driven architecture, called the ETL data-driven Machine-3 (EM-3). The EM-3 is basically oriented to symbol manipulation and aims at bringing out the intrinsic parallelism in ordinary programs.

The EM-3 is a new generation Lisp machine in the sense that the basic technology is on data-driven architecture.

Recently, many types of data-driven machines have been proposed but few of these are prototype [1]. For symbol manipulation use there are only a few plans such as that of the University of Utah [2] and the Electrical Communication Laboratory of NTT [3]. The model of the University of Colorado [4] is related to ours in some points but is independently conceived. These data-driven machines have such a ‘good’ property of parallelism that programming for parallel execution does not require a special language construct. A program in some data-driven language is executed in a parallel processing manner in accordance with the natural data dependencies between the operations in the program.

The design principles of the EM-3 are summarized as follows:

(1) Lisp-based machine: As a user interface a Lisp-like language called Emlisp is assumed. The Emlisp is a functional single-assignment language.

(2) Parallel evaluation: The mechanism of computation leads to parallel evaluation of ‘suspension’ in a lazy evaluation scheme. So the computational capability is the same as lazy evaluation, but the control of evaluation is carried out eagerly.

(3) Distribution of structure memories: Storages needed for list structures are distributed over multiple processing elements (PE). Each PE has a local store with a common addressing space.

2. Function evaluation scheme

The EM-3 has very innovative control features in order to achieve parallel lazy evaluation.

First, the notion of a ‘pseudo-result’ is introduced in describing parallel lazy evaluation. Function execution causes the generation of a pseudo-result in the control mechanism as shown in Fig. 1. Similar to other data-driven models, when and