Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 190 (2017) 296 – 303

Procedia Engineering

www.elsevier.com/locate/procedia

Structural and Physical Aspects of Construction Engineering

Parallel Execution of Structural Mechanic Tasks with Use of Small Supercomputers

Jiri Brozovsky [a,]*Jiri Koktan[b]

[a]*Jiri Brozovsky, VSB-TU of Ostrava, Faculty of Civil Engineering, L. Podeste 1875, Ostrava, CZ70833, Czech Republic*
[b]*Jiri Koktan, VSB-TU of Ostrava, Faculty of Civil Engineering, L. Podeste 1875, Ostrava, CZ70833, Czech Republic*

Abstract

The paper deals with selected approaches to speed-up numerical solutions of particular civil engineering mechanics problems. A short overview of common approaches is given and one particular approach is discussed in detail. The use of the selected approach is demonstrated on numerical examples.
© 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the organizing committee of SPACE 2016

Keywords: Structural mechanics; parallel processing; Winkler foundation; linear elastic problems.

1. Introduction

The paper deals with selected approaches to speed-up numerical solutions of particular civil engineering mechanics problems. The high level of computational power of contemporary personal computers (including tablets and mobile phones) is often achieved by using multi-core central processing units (CPUs). It allows to concurrently run several programs at non-reduced speed and it makes also possible to write computational programs which use several CPU cores at once in order to speed-up their run.

The full utilization of multi-core processors, however, requires considerable changes of program code. The contemporary computers often offer the possibility of speed-up of computational programs by use their multi-core central processor units (CPU). The multi-core processors are today common not only in the personal computers (desktops and laptops) but also in tablets and phones. Numerical codes can utilize several processor's cores by dividing

* Corresponding author. Tel.: +420-597-321-321; fax: +597-321-358.
E-mail address: jiri.brozovsky@vsb.cz

1877-7058 © 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the organizing committee of SPACE 2016
doi:10.1016/j.proeng.2017.05.341

the computation to several processes which can run on individual processor cores. The computer programs have been traditionally written for single-processor/single core machines so full exploitation of such possibility needs changes of program codes.

There are also situations where it is useful to concurrently run several instances of a numerical program which was designed to run on just one processor. For example, many real problem of civil engineering statics require analysis of several loads steps which can be computed independently. There are several types of program tools which can be used for automatic execution of parallel instances of a single program, for example the GNU Parallel [2].

Another typical example is a reliability-based structural assessment or other type of-reliability based computational analysis. The Monte Carlo method is often used for these problems [8]. This method is based on a large numbers of repeated computations (usually about 1 000 000 of computations for structural reliability tasks) which use randomly-generated input data. These computations are often almost independent. The main problem is usually a quality random number generator which can serve data for parallel running processes or programs. The SPRNG library is often used here [1]. An example of a program which utilizes the SPRNG library is the Monte [6] (Fig. 1) which can be connected to the uFEM finite element package [7].

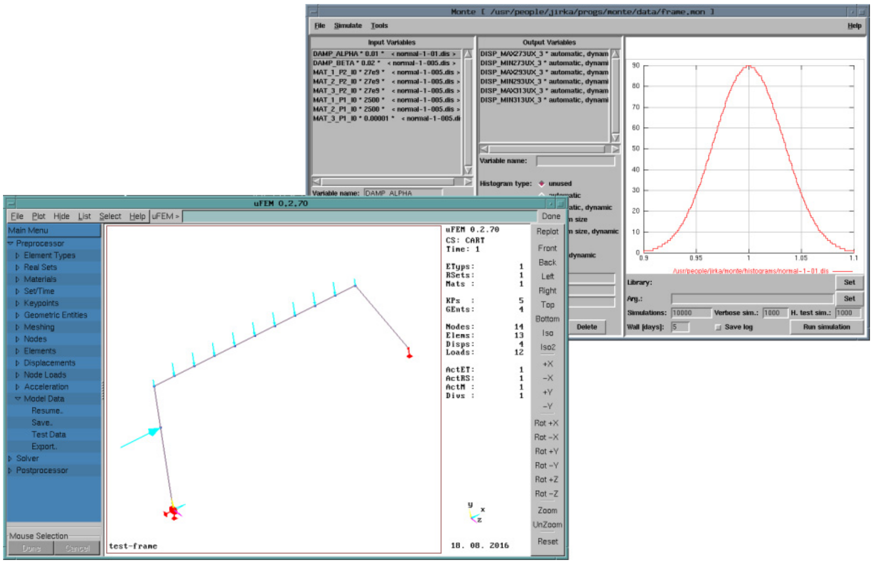

Fig. 1. Combination of a structural reliability tool based on the Monte Carlo Method and a Finite Element Method Code.

However, often it is important to speed-up an analysis of a single problem which may be time-consuming but which cannot be easily divided to several independent parts or sub problems. Many computational approaches are available to solve such problems: from a relatively simple parallelization of solution of linear systems [10] to complex domain distribution methods, often based on the FETI method [9].

The programming part of the problem depends on the technical approach. Traditionally the parallel processing has been done on parallel supercomputers which have been often based on number of interconnected processing units. For these approaches the Message Passing Interface standard has been created and it has been used in many software implementations, for example [4]. For the computers with multi-core processors, however, it can be used a less complex approach based on a threads. Such approach needs a shared computer memory which is available for all CPU cores. This approach is available for a long time and it is available on many computers platforms [5].

Download English Version:

https://daneshyari.com/en/article/5027209

Download Persian Version:

https://daneshyari.com/article/5027209

Daneshyari.com