A POWERFUL SOFTWARE FOR APPLYING MASSIVELY PARALLELIZED SUPERCOMPUTERS TO THE MODELING OF GEOPHYSICAL SYSTEMS

Ismael Herrera-Revilla

Instituto de Geofísica
Universidad Nacional Autónoma de México (UNAM)
Apdo. Postal 22-220, México, D.F. 14000
Email: iherrerarevilla@gmail.com

SUMMARY

The basic models of mathematical geophysics are systems of partial differential equations whose solution methods require the use of the most powerful hardware available. Today, the most powerful computers are parallel computers. The main difficulties for applying such computers to the solution of partial differential equations are associated with the coordination of the many processors that carry out the different tasks and the information-transmission between them. At present, the most effective procedures for overcoming such difficulties are non-overlapping domain decomposition methods [1]. However, the application of such methods is case-specific to a large extent. Recently, Herrera and coworkers [2-11] have developed a novel methodology, the *derived-vector-space domain decomposition method (DVS-DDM)*, which allows the construction of software that achieves higher degrees of parallelization (measured by its speed-up) and furthermore is case-independent. Whenever a conventional solver is available at each one of the processors that constitute the parallel hardware, application of the case-independent DVS-software yields a code that solves the overall problem in parallel. In this talk a general description of the DVS-software is given and its underpinnings explained.

REFERENCES

[1]. DDM Organization, Proceedings of 22 International Conferences on Domain Decomposition Methods www.ddm.org , 1988-2013.

[2]. Herrera, I., L.M. de la Cruz and Rosas-Medina A. "Non Overlapping Discretization Methods for Partial, Differential Equations". NUMER METH PART D E, 2014, DOI I0.I002/num 21852 (Available on line: Open source)

[3]. Herrera, I. & Rosas-Medina A. "The Derived-Vector Space Framework and Four General Purposes Massively Parallel DDM Algorithms", EABE (Engineering Analysis with Boundary Elements), **37** pp-646-657, 2013.

[4]. Carrillo-Ledesma A. & Herrera I. & de la Cruz Luis Miguel. "Parallel Algorithms for Computational Models of Geophysical Systems". Geofísica Internacional, **52 (**3) pp., 293-309 2013

[5]. Herrera, I., Rosas Medina Alberto. "The Derived-Vector Space Framework and Four General Purposes Massively Parallel DDM Algorithms". EABE (Engineering Analysis with Boundary Elements), **37** (3) pp-646-657, 2013

[6]. Herrera, I., Carrillo-Ledesma A. & Rosas-Medina Alberto "A Brief Overview of Non-overlapping Domain Decomposition Methods", Geofisica Internacional **50**(4), pp 445-463, 2011

[7]. Herrera, I. & Yates R. A. "The Multipliers-Free Dual Primal Domain Decomposition Methods for Nonsymmetric Matrices" NUMER. METH. PART D. E. **27**(5) pp. 1262-1289, 2011. (Published on line April 28, 2010) DOI 10.1002/Num. 20581

[8]. Herrera, I. & Yates R. A. "The Multipliers-free Domain Decomposition Methods" NUMER. METH. PART D. E. 26: 874-905 July 2010 (DOI 10.1002/num. 20462)

[9]. Herrera I. and R. Yates "Unified Multipliers-Free Theory of Dual Primal Domain Decomposition Methods". NUMER. METH. PART D. E. Eq. 25:552-581, May 2009, (Published on line May 13, 08) DOI 10.1002/num. 20359

[10]. Herrera, I. "New Formulation of Iterative Substructuring Methods without Lagrange Multipliers: Neumann-Neumann and FETI", NUMER METH PART D E **24**(3) pp 845-878, 2008 (Published on line Sep 17, 2007) DOI 10.1002 NO. 20293

[11]. Herrera, I. "Theory of Differential Equations in Discontinuous Piecewise-Defined-Functions", NUMER METH PART D E, **23**(3), pp 597-639, 2007 DOI 10.1002 NO. 20182