The DVS algorithms: General description and evidences that they are top for treating PDEs in highly parallelized computers

*†Ismael Herrera and Iván Contreras

Instituto de Geofísica, Universidad Nacional Autónoma de México (UNAM)

*Presenting author: iherrerarevilla@gmail.com †Corresponding author: iherrerarevilla@gmail.com

<u>Abstract</u>. Ideally, DDMs seek the DDM-paradigm: "constructing the <u>global</u> solution by solving <u>local</u> problems, exclusively". To achieve it, it is essential to disconnect the subdomain-problems. This explains in part the success of non-overlapping DDMs. However, a limitation of standard versions of such methods is that some nodes are shared by several subdomains. Recently such a limitation has been removed in an improved kind of non-overlapping DDMs: the *derived-vector-space* (DVS) approach to the parallel processing of PDEs. In this paper a general description of DVS-methods is presented, together with numerical results that exhibit their outstanding performances of the order of 90% parallelization efficiencies.

Key Words: Parallel Software for PDEs, High Performance Computing, HPC, Parallel Computing, Domain Decomposition Methods (DDM)

REFERENCES

- [1] Herrera, I., de la Cruz L.M. and Rosas-Medina A. "Non-Overlapping Discretization Methods for Partial, Differential Equations". NUMER METH PART D E, <u>30</u>: 1427-1454, 2014, DOI 10.1002/num 21852. (Open source).
- [2] 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.
- [3] Herrera, I. & I. Contreras. "An Innovative Tool for Effectively Applying Highly Parallelized Hardware to Problems of Elasticity". Geofísica Internacional, **55** (1) pp., 363-386, 2016.
- [4] 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.
- [5] Herrera, I. & Yates R. A. "<u>The Multipliers-free Domain Decomposition Methods</u>" NUMER. METH. PART D. E. 26: 874-905 July 2010 (DOI 10.1002/num. 20462)
- [6] Herrera, I. & Yates R. A. The Multipliers-Free Dual Primal Domain Decomposition Methods for Nonsymmetrical Matrices NUMER. METH. PART D. E. 27(5) pp. 1262-1289, 2011. DOI 10.1002/Num. 20581.