

Development of a library of iterative solvers based on the domain decomposition method

†M. Ogino¹ and *R. Shioya

¹Information Technology Center, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8601, Japan

²Faculty of Information Sciences and Arts, Toyo University, 2100 Kujirai, Kawagoe 350-8585, Japan

*Presenting author: masao.ogino@cc.nagoya-u.ac.jp

†Corresponding author: shioya@toyo.jp

Abstract

The ADVENTURE [Yoshimura et al. (2002)] is the specialized computer aided engineering system for the large-scale finite element analysis. For instance, the ADVENTURE Solid [Miyamura et al. (2002)], which is an elastic-plastic finite element solver, has successfully solved a 100 billion degrees of freedom problem [Ogino and Shioya (2014)], and moreover has been used to simulate and predict of behavior of artifacts [Yoshimura et al. (2014)]. The ADVENTURE employs the domain decomposition method (DDM) as a numerical algorithm to solve the linear equations [Glowinski et al. (1983)][Yagawa and Shioya 1994]. The DDM is well-known method for its high parallel efficiency. The DDM constructs the Schur complement to an original system to be solved, and solves it by the iterative methods. In the ADVENTURE system, the DDM is implemented by implicit construction of the Schur complement. Thereby, the program structure of the ADVENTURE is too complexity. For this reason, it is difficult to evaluate and develop an iterative method or a preconditioner for the DDM by using the ADVENTURE. To solve these problems, we developed a parallel DDM library for the finite element analysis with explicit construction of the Schur complement equation. Especially, two methods for parallel construction of the Schur complement equation were proposed. These methods are based on a global Schur complement and a local Schur complement, respectively. In this study, an abstract of development library is explained, and some numerical examples are demonstrated.

Keywords: Domain Decomposition Method, Iterative Solvers Library, Parallel Computing

References

- Yoshimura, S., Shioya, R., Noguchi, H., and Miyamura, T. (2002) Advanced general purpose computational mechanics system for large-scale analysis and design, *J. Comput. Appl. Math.* **149**-1, 279-296.
- Miyamura, T., Noguchi, H., Shioya, R., Yoshimura, S., and Yagawa, G. (2002) Elastic-plastic analysis of nuclear structures with millions of DOFs using the hierarchical domain decomposition method, *Nuclear Eng. Design* **212**, 335-355.
- Ogino, M. and Shioya, R. (2014) Scalable non-overlapping domain decomposition method for finite element simulations with 100 billion degrees of freedom model, *COMPSAFE2014*.
- Yoshimura, S., Kobayashi, K., Akiba, H., Suzuki, S., and Ogino, M. (2014) Seismic response analysis of full-scale boiling water reactor using three-dimensional finite element method, *Journal of Nuclear Science and Technology* **52**, 4, 546-567.
- Glowinski, R., Dinh, Q. V., and Periaux, J. (1983) Domain decomposition methods for nonlinear problems in fluid dynamics, *Computer Methods in Applied Mechanics and Engineering* **40**, 27-109.
- Yagawa, G. and Shioya, R. (1994) Parallel finite elements on a massively parallel computer with domain decomposition, *Comput. Syst. Eng.* **4**, 495-503.