Computational Mathematics Seminar Series

A Domain Decomposition Method based on Augmented Lagrangian with a Penalty Term

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Abstract:
Domain decomposition (DD) methods are widely used as fast and efficient solvers for a large sparse system of linear equations arising from the finite element discretization for boundary value problems. In general, DD methods are classified into two categories according to types of partitions of a domain into subdomains; one is an overlapping DD and the other is non-overlapping DD including an iterative substructuring method. In the approach of non-overlapping DD, it is well-known in a variational framework that for second-order elliptic problems, the weak solution is equivalent to the minimizer of the energy functional defined by a sum of the local energy on partitioned subdomain if the trace continuity across the interface is satisfied. In this view, how to impose the continuity constraint on the interface is the key issue in the field of non-overlapping methods. In this talk, we propose a dual iterative substructuring method with a penalty term, which is a variant of the FETI-DP method based on the way to deal with the continuity constraint on the interface. The FETI-DP method is one of the most advanced dual iterative substructuring methods, which introduces Lagrange multipliers to enforce the pointwise matching condition on the interface. The proposed method imposes the continuity by not only the pointwise matching condition on the interface but also using a penalty term which measures the jump across the interface. For a large penalization parameter, it is shown that the condition number of the resultant dual problem is bounded by a constant independent of both the subdomain size H and the mesh size h. From the implementational viewpoint of the proposed method, the difference from the FETI-DP method is to solve subdomain problems which contain a penalty term with a penalization parameter. To prevent a large penalization parameter from making subdomain problems ill-conditioned, we pay special attention to establish an optimal preconditioner with respect to a penalization parameter. Finally we present numerical results.

Speaker's Bio:
I am a KRF (Korea Research Foundation) postdoctoral fellow working under the supervision of Susanne C. Brenner. I earned my Ph.D. in Mathematical Sciences at the Korea Advanced Institute of Science and Technology (KAIST). My research interests include numerical methods for PDEs, domain decomposition methods, parallel computation.

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