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|  | Seminar on BEM and Related Topics |
| **主講者:** | 陳正宗教授 (海洋大學) |
| **講題:** | A self-regularized method for rank-deficiency systems in BEM and FEM |
| **時間:** | 2015-06-09 (Tue.)  15:00 - 16:00 |
| **地點:** | 數學所 617 研討室 (台大院區) |
| **Abstract:** | It is well known that a rank-deficiency system appears in the degenerate scale once BEM is used for the Dirichelet problem. For the Neuman problem, either FEM or BEM yields a rank-deficient matrix. Fredholm alternative theorem plays an important role in the linear algebra when the matrix is singular. Based on the singular value decomposition (SVD) for the matrix, range deficiency can be easily and systematically understood. By introducing a slack variable, we obtain a bordered matrix by adding one column vector from the left unitary vector and one row vector from the right unitary vector with respect to the zero singular value. It is interesting to find that an original singular matrix is regularized to a non-singular one. The value of the slack variable indicates the infinite solution (zero) or no solution (non-zero) for the linear algebraic system. To demonstrate this finding, one triangular-domain problem with a degenerate scale and a rigid body mode is solved. Although influence matrices are singular in the BIE formulation for different problems (degenerate scale in the Dirichlet problem and rigid body mode in the Neumann problem), the corresponding unique solution (Dirichlet problem) and infinite solutions containing a constant potential (Neumann problem) can be obtained by using the bordered matrix and SVD technique. In addition, singular stiffness matrices using the FEM for free-free plane and space trusses are also regularized to find a reasonable solution.  Keywords: Fredholem alternative theorem, SVD, bordered matrix, range deficiency, regularized method  References  [1] J. T. Chen, W. S. Huang, J.W. Lee and Y. C. Tu , 2014 , A self-regularized approach for deriving the free-free stiffness and flexibility matrices, Computers and Structures, Vol.145, pp.12-22.  [2] J. T. Chen, H. D. Han, S. R. Kuo and S. K. Kao, 2014, Regularized methods for ill-conditioned system of the integral equations of the first kind, Inverse Problem in Science and Engineering, Vol.22, No.7, pp.1176-1195.  [3] 韓厚德, 李應德, 殷東生, 陳正宗, 2015,一種第一類Fredholm 積分方程組解的存在唯一性的充分必要條件.(《中國科學：數學》慶賀林群院士80華誕專輯論文邀稿)  [4] J T Chen, Y L Chang, S K Kao and J Jian, 2015, Revisit of indirect boundary element method: sufficient and necessary formulation, Journal of Scientific Computation, Accepted. |