Ghost-point Based Radial Basis Function Collocation and Two-step MPS-MFS Methods with Variable Shape Parameters

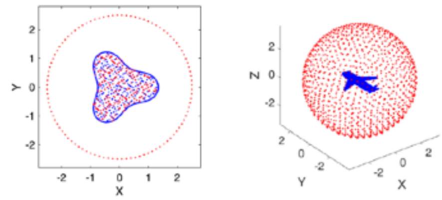
變量形狀參數於虛擬點為基礎之徑向基函數選點法與兩步特解基礎解法之應用

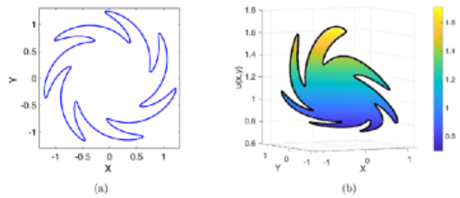
Abstract

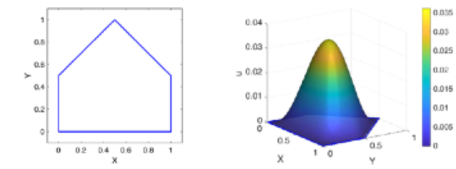
Meshless methods were first created in the 1970s. Among meshless methods, the radial basis function (RBF) collocation method (RBFCM) used for solving partial differential equations (PDE) is one of the most popular research topics. Another similar numerical scheme is the method of fundamental solutions (MFS). In 1996, the method of particular solutions (MPS) was proposed to extend the ability of MFS to solve inhomogeneous problems. One notable feature of MPS is the ability to approximate a particular solution with RBFs; the treatment simplifies the procedure in MPS.

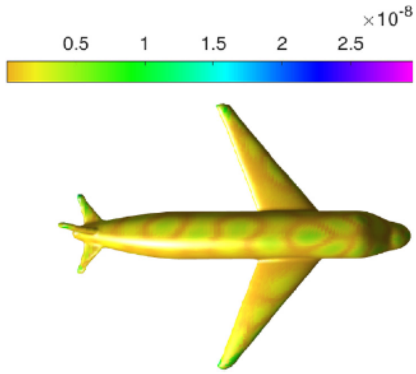
However, in conventional RBFCM, the centers are usually taken as being the same as collocation points. Another issue in dispute is the selection of shape parameters. The shape parameter in an RBF is a free parameter that controls the smoothness of the basis function. Unfortunately, selection of this parameter strongly depends on the problem. In MPS, the particular solution is approximated with RBFs. Hence the same problems also occur in the MPS method. The objective of our research is to diminish the dependency of variables on problems and reduce the approximation error.

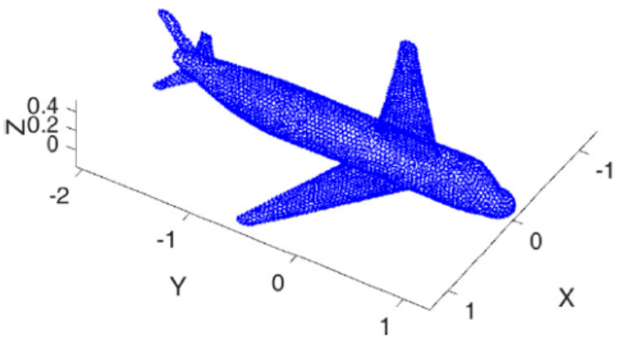
This study proposes an algorithm for the solution procedure of RBFCM and MPS-MFS. The proposed algorithm includes the ghost point method and variable shape parameters. In the ghost point method, the centers and collocation points are different point sets. The variable shape parameters are introduced. A new strategy is proposed to determine the interval of the variable shape parameters for the ghost point method using RBFs and for MPS.











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