Nonuniqueness and treatment in dual BIEM/BEM using SVD

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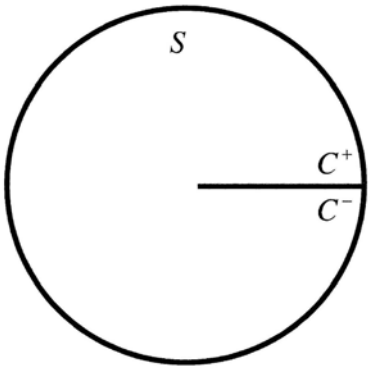
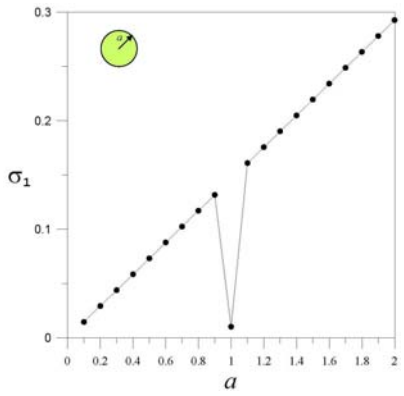
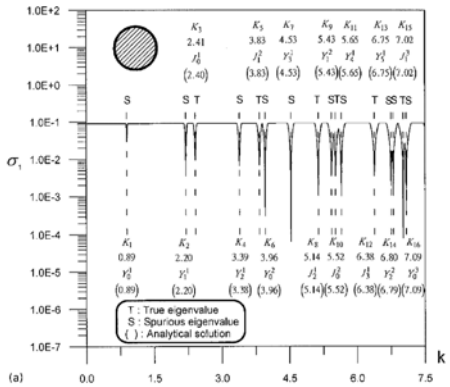
Nonuniqueness occurs in the BIEM/BEM for boundary value problems containing degenerate scale, degenerate boundary, spurious eigenvalue and fictitious frequency as shown in Figure 1. By employing the SVD technique with respect to the four influence matrices in the dual BEM, the degenerate mechanism can be studied in a unified manner. True information in physics due to rigid body mode and true eigensolution is found in the right unitary vector with respect to the corresponding zero singular value while the spurious information in mathematics due to degenerate boundary, degenerate scale, spurious eigenvalue and fictitious frequency is imbedded in the left unitary vector as shown in Figure 2. The SVD updating term is employed to extract the true information while SVD updating document is utilized to filter out the spurious information. Null field and nonzero field in the complementary domain for the normal case and the degenerate case, respectively, are both plotted. Treatment to ensure the unique solution by using CHIEF, CHEEF and Burton-Miller approach is also examined. Several examples including degenerate boundary, degenerate scale, spurious eigenvalue and fictitious frequency are demonstrated to see the unified formulation.



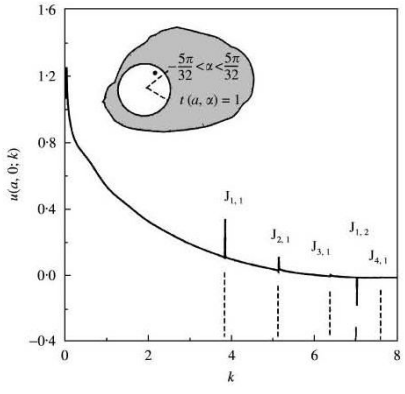
(a) Degenerate boundary



(b) Degenerate scale



(c) Spurious eigenvalue



(d) Fictitious frequency

Figure 1: Degenerate mechanism in BIEM/BEM

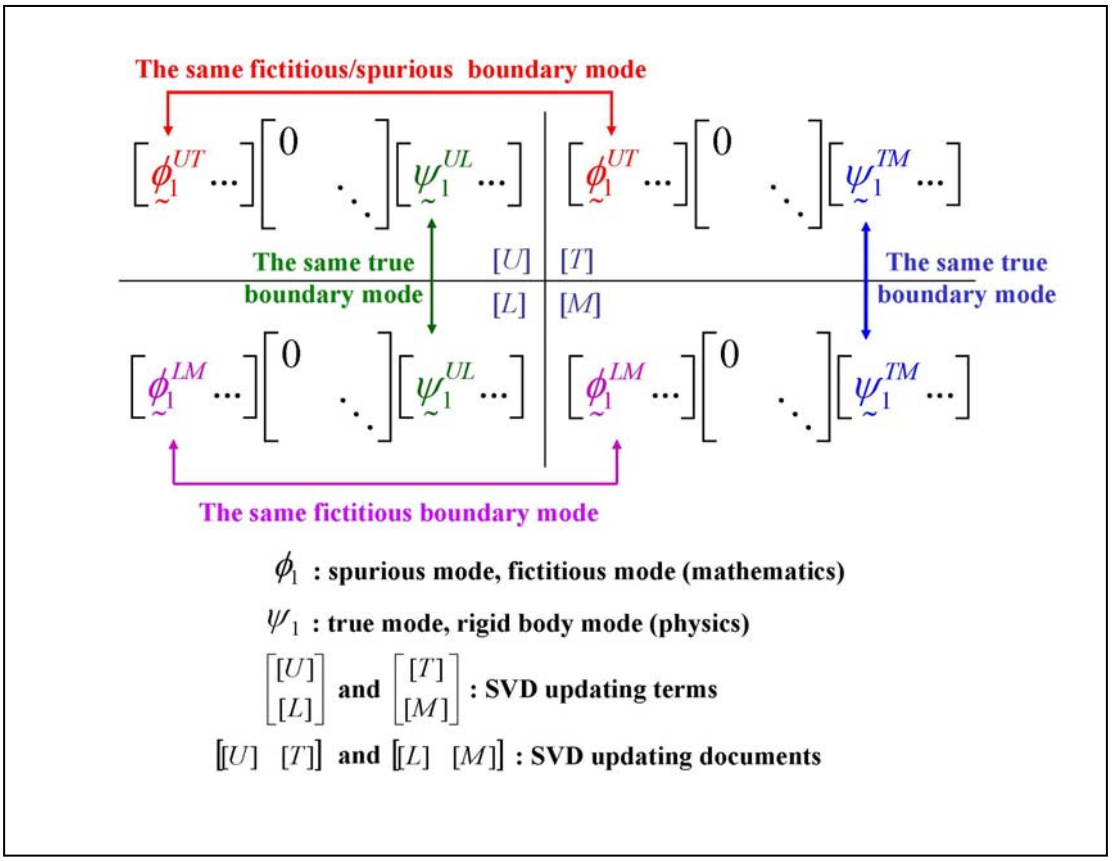


Figure 2: SVD structure for the four influence matrices in the dual BIEM/BEM

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