结构－地基动力相互作用时域数值分析的显－隐式分区异步长递归算法

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摘要　动力相互作用时域数值分析的精度与效率是面向大规模工程问题解决的重要问题。在阻尼溶剂抽取法模拟地基无限域动力性质的基础上，提出并发展了结构－地基动力相互作用时域数值分析的显－隐式分区异步长递归算法，分别在结构、地基分区计算中进行大步长隐式与小步长显式求解，而且采用预报－校正显式积分与Newmark隐式积分，具有相同的运动量数值积分假定，可自然满足分区交界面位移协调性条件。在满足工程精度要求的条件下，分区异步长显－隐式求解算法使动力相互作用时域数值计算效率较传统小步长显式积分算法得到大幅度提高，可明显促进阻尼溶剂抽取法在大规模工程问题分析中的应用。并就积分时间步长、结构－地基交界面异步长内插格式及位移协调性关系对结构动力响应的影响进行数值对比研究，可为具体计算中的参数选择提供依据。

关键词　基础工程；结构－地基动力相互作用；分区递归时域算法；阻尼溶剂抽取法；分区异步长；时域数值算法

分类号

A SUB-REGIONAL EXPLICIT-IMPLICIT RECURSIVE METHOD WITH MIXED STEP-SIZE STRATEGY IN TIME DOMAIN FOR DYNAMIC STRUCTURE-FOUNDATION INTERACTION ANALYSIS

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Abstract
 To satisfy the requirement of large engineering problems，evaluation efficiency and accuracy have played important roles in the application of time-domain numerical solution. Based on the damping

solvent extraction method(DSEM)，a new sub-regional explicit-implicit recursive method with mixed step-size strategy in time domain is proposed to cope with the numerical analysis of dynamic structure-foundation interaction，which can alternatively apply implicit and explicit integral algorithms with different time steps to the computations of structure region and soil region. This method is convenient to combine the numerical advantages of big calculated time steps in implicit numerical integration and wide applicability for explicit integration. According to the same displacement interpolation relations in single time step for the explicit prediction-correction and implicit Newmark-b integral arithmetic，the deformation compatibility on the interface between structure and soil region can also be naturally guaranteed. Finally，key influential factors for the implementation，such as integral time step and various displacement interpolations on the interface，are also numerically discussed in the detailed practical application，which shows that the new proposed method can efficiently improve the evaluation efficiency under the condition of satisfying engineering accuracy well.

Key words foundation engineering；dynamic structure-foundation interaction；sub-regional time domain reciprocal algorithm；damping solvent extraction method(DSEM)；sub-regional multiple step-size；time-domain numerical algorithm

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