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动力刚度法求解平面曲梁面外自由振动问题

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DYNAMIC STIFFNESS METHOD FOR OUT-OF-PLANE FREE VIBRATION ANALYSIS OF PLANAR CURVED BEAMS

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全文: PDF (325 KB) HTML (0 KB) 输出: BibTeX | EndNote (RIS) 背景资料

摘要 该文将动力刚度法应用于平面曲梁面外自由振动的分析。通过建立单元动力刚度所满足的常微分方程边值问题,用具有自适应求解功能的常微分方程求解器COLSYS 进行求解,获得单元动力刚度的数值精确解。以COLSYS 求解单元动力刚度的网格作为单元上固端频率计数求解的子网格,由单元动力刚度的边值问题解答线性组合出该子网格下各子单元的动力刚度,由Wittrick-Williams 算法获得单元固端频率的计数。从而实现整体结构的Wittrick-Williams频率计数。通过建立单元动力刚度对频率的导数所满足的常微分方程边值问题,调用COLSYS求其数值精确解,并将其引入导护型牛顿法,可迅速求得结构精确的频率和振型。数值算例表明,该文方法准确、可靠、有效。

关键词: 动力刚度法 导护型牛顿法 Wittrick-Williams算法 平面曲梁 面外自由振动

Abstract: This paper extends the dynamic stiffness method to the out-of-plane free vibration analysis of planar curved beams. The boundary value problem (BVP) for ordinary differential equations (ODEs) which governs element's dynamic stiffnesses is set up and solved by ODE solver COLSYS to get the numerical exact values of element's dynamic stiffnesses. The mesh generated by COLSYS in solving such ODEs is taken as a sub-mesh to calculate the counting of element's fixed-end frequency. On this sub-mesh, each sub-element's dynamic stiffnesses are reduced to linear combination of such ODE solutions. Thus by implementing Wittrick-Williams algorithm on each element, its fixed-end frequency counting is obtained. The derivatives of the dynamic stiffnesses to the frequency are also reduced to solve corresponding ODEs by using COLSYS. Thus the guided and guarded Newton method is set up and structural exact frequencies and vibration modes can be obtained. The numerical examples demonstrate that this method is accurate, reliable and effective.

Key words: dyanmic stiffness method guided and guarded Newton method Wittrick-Williams algorithm planar curved beam out-of plane free vibration

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