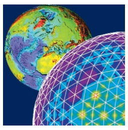
product option

LUSAS
Finite Element Analysis

Dynamic Analysis



The LUSAS Dynamics Option contains facilities to solve a wide range of dynamic problems in the time and frequency domains. By combining the LUSAS Dynamic and LUSAS Nonlinear options both high and low velocity nonlinear impact problems can be solved using either implicit or explicit solution techniques.

Transient Dynamic Analysis

Transient Dynamic analysis is usually carried out to provide the solution to nonlinear dynamics problems when material nonlinearity, geometric nonlinear effects or changes in boundary conditions occur due to dynamic events. When carrying out a transient dynamic analysis both distributed and discrete damping may be specified. Damping is defined by specifying mass and stiffness Rayleigh damping constants. By combining the LUSAS Dynamic and LUSAS Nonlinear options both high and low velocity nonlinear dynamic problems can be solved using either implicit or explicit solution techniques.

Implicit Transient Dynamics

Implicit dynamic analysis is used to solve "low velocity" problems where low frequency effects dominate the response. Typical applications include sesmic analysis or plant and structures (including soil structure interaction), low velocity impact and analysis of deformable blast panels. LUSAS has a highly accurate state-of-the-art facility based on the second order Hilber-Hughes-Taylor algorithm. This algorithm is self-starting (meaning no preliminary static solution is required) and allows variable time steps to be used. It is unconditionally stable for linear problems enabling large time steps to be taken without loss in stability. An automatic time step computation is available if required. The implicit dynamics option is available for all implicit element types with either consistent or lumped mass idealisation and may also be combined with the other analysis options.

Superelements

For large dynamic problems superelements may be used to reduce the size of the model while accurately including the boundaries effects. This is achieved by including generalised internal modes within the superelement matrices. This technique can be used for both linear and nonlinear dynamic analyses.

Explicit Transient Dynamics

For high velocity dynamic problems where shock waves dominate the time step has to be very small. In these situations, explicit dynamic analysis is the most appropriate and efficient solution technique. The explicit dynamics algorithm within LUSAS has been vectorised to enable rapid solutions to be obtained. Dedicated, optimised, single Gauss point explicit dynamics elements are provided with hourglass control to avoid mechanisms. Furthermore, Eulerian geometric nonlinearity is automatically invoked in these elements to effectively handle the large strains which often occur in such analyses. To optimise the procedure required still further, automatic time stepping is provided to ensure that an accurate and efficient solution is obtained.

Nonlinear Boundary Conditions

In both implicit and explicit analysis a slideline facility allows contact between discrete bodies to be modelled in two and three dimensions even when the meshes across adjacent contacting surfaces are incompatible. A nodal monitoring procedure within the algorithm enables contact and rebound to be handled automatically avoiding the need to manually define contact joint elements between contacting nodes. A tied slideline option also exists which can be used to eliminate the need to define a transition mesh region between areas of the model with different degrees of mesh refinement. Friction is modelled using a Coulomb friction model which may be included in the contact algorithm.

Restart facility

The LUSAS restart facility provides a high level of control over successive increments of a nonlinear or dynamic analysis. With the restart facility all

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analysis data can be optionally saved between successive increments. This has an important benefit for extremely large problems where disk space may be a critical factor. Analyses which have been interrupted or terminated before completion may be restarted from the last converged solution.

Loading

In addition to the standard loading available in LUSAS, tabular input of displacement, velocity and acceleration time histories provide efficient control over the application of loading and is especially suited to seismic studies. Variations of loading with time may also be defined using the comprehensive load curve facility. This enables multiple load variations to be defined and assigned to different loading actions as required.

Results Processing

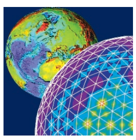
In addition to the powerful contouring, graphing and result plotting features in LUSAS, a large number of specific dynamics results processing features are available including:

- Generation of time histories over multiple results files of any node or Gauss point result value
- Animation of load cases over multiple time steps and over multiple results files.
- Selective results history to speed post processing and reduce data storage requirements
- Links to LMS Software for validation and updating of modal models

LUSAS
Finite Element Analysis

Dynamic Analysis

- Forced response
- Spectral response
- Transient dynamics
- Nonlinear dynamics
- Impact Analysis
- Implicit or explicit solution algorithms
- Variable time step selection
- Automatic time step algorithm
- Time dependent boundary conditions and loading
- Comprehensive Load curve facility
- Choice of consistent or lumped mass
- Viscous (modal) damping



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