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Dynamic Bushing and Hydromount

A new force element, the "Dynamic Bushing and Hydromount", force element 042 (FE 042), is available with SIMPACK 8.902. Users can now easily switch between various levels of complexity when simulating models with amplitude and frequency dependent force elements. A method for correlating the input parameters with measurement data has also been developed.

APPLICATION AREA

This element can be used when modelling any type of mounts, bushings or torsion couplings, which are commonly used within the Automotive, Engine, Rail, Wind, and other industrial sectors. Typical applications would be suspension bushings, engine hydro-mounts, crankshaft rotational dampers, support arm bushings and generator mounts.

PREVIOUS SOLUTION METHODS

Common practice is to use a parallel coupling of a spring and damper element to define the basic elastomer properties, e.g. FE 043 ("Bushing") with the resulting property of increasing loss angle with increasing frequencies. This is not realistic, and therefore, particular attention needs to be paid to the damping value used. Alternatively, additional element(s) with serial coupling of spring and damper (so-called Maxwell elements) can be used in order to include frequency dependent damping and stiffness, e.g. FE 086 ("Spring-Damper serial/parallel"). FE 220 ("Non-Linear Elastomer"), with an additional static hysteresis approach, can also be used in order to consider both the frequency and the amplitude dependency.

For hydromounts, FE 091 ("Hydraulic Bearing"), which includes the hydrodynamic effect and fluid specific quadratic damping, can be used.
The new FE 042 includes the physical properties of all these elements (see Fig. 1) and some new approaches for the modelling of static hysteresis and hydrodynamic effect.

ELEMENT COMPONENTS

The new FE 042 uses a parallel coupling of a spring and viscous damper, serial spring-damper elements, an element for modelling static hysteresis, and an element for modelling the hydrodynamic effect. Each of these elements can be easily switched on or off, by way of parameters, in order to define different levels of model complexity (e.g. influence of hydrodynamic effect, influence of amplitude dependency, etc.) Different approaches for modelling the amplitude dependency can be defined within this element:

- logarithmic hysteresis function (similar to FE 220 ("Non-Linear Elastomer"))
- rational hysteresis function
- rational hysteresis function with additional scaling in order to include the hysteresis loop symmetry

The hydromount (Fig. 2) modelling approach takes the following effects into account:

- dynamic stiffness and loss angle alteration due to fluid mass oscillation
- linear and quadratic hydromount damping
- hydromount membrane clearance
- stiffness degression due to cavitation

PARAMETER FITTING

In order to avoid time consuming data correlation, a new method will be introduced into SIMPACK. This approach is based on the analytically solved dynamic stiffness and loss angle. Using "value-sliders" to fit the analytical curves with the measured frequency response data, the force element parameters may be easily found (see Fig. 3). Typically, measured curves of dynamic stiffness and loss angle for two or three different amplitudes with respect to the frequency are used for the parameter fitting.

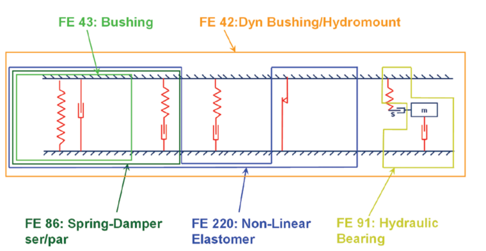

Fig. 1: Force element components

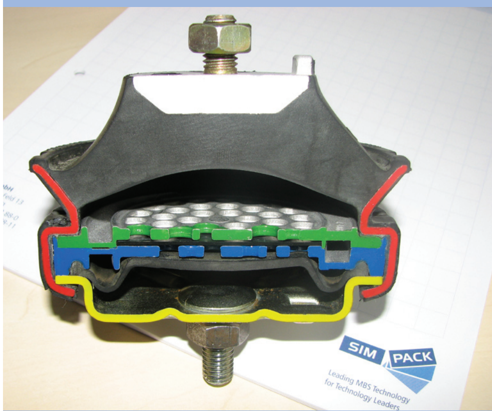

Fig. 2: Hydromount

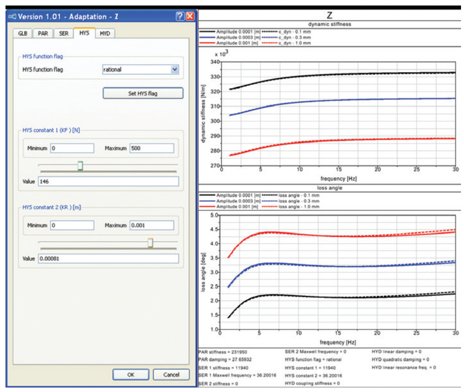

Fig. 3: Parameter fitting