

CADFEM Consulting

Multibody Dynamics of an Automotive Device

ANSYS® Rigid and Flexible Transient Analysis

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Task

The driving mechanism of an automotive device respectively the driving moment has to be designed such that vibration amplitudes of 5g are achieved. An electric motor gives a short moment impulse (blue arrow on the top figure) to an eccentric. The rotation is transformed into a translational motion by an elastic beam and the vibrating device is suspended to ground by a spring-damper mechanism. After switching off the moment the free vibration amplitude shall be 5g at the beginning.

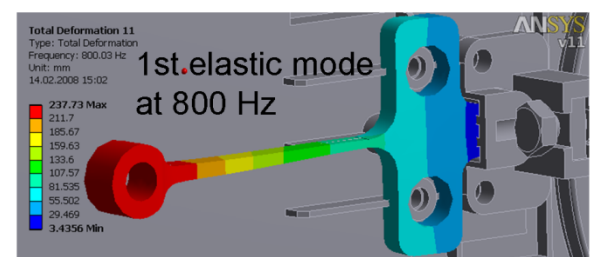
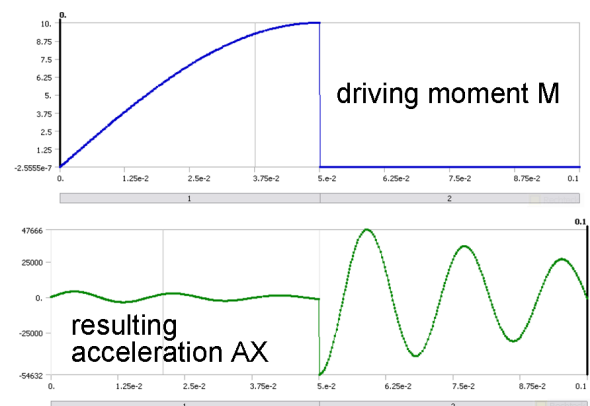
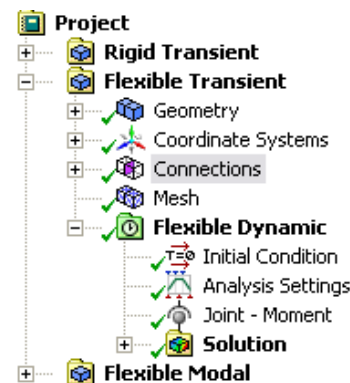
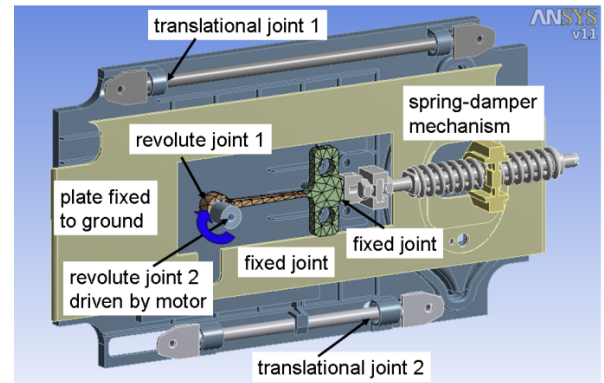
Solution

The vibration behavior is dominated by the coil spring. The elastic modes of the device itself are assumed to be considerably higher. For that reason a rigid transient analysis for the multibody system (MBS) is set up in ANSYS (see feature tree in the figure). After importing the CAD model to ANSYS DesignModeler™ rigid assemblies are grouped together and rigid parts are connected via joints. Different kind of joint elements (spherical, translational, universal, ...) can be configured by imposing appropriate kinematic constraints on any, or some, of the six relative degrees of freedom of two components. After loading the revolute joint of the eccentric by a transient moment signal (blue curve) the desired acceleration response of the device can be computed (red curve).

Modeling a part's flexibility can be moderately important, or it can be critically important. In this case the long slender driving beam was suspected of having some impact on the final result. Within the same GUI ANSYS allows switching between rigid and flexible bodies. In this case the beam has been tagged to be flexible resulting in a FE meshed part (see top figure). A modal analysis gives the first desired mode of the vibrating spring-mass system at 60Hz followed by the first elastic beam mode at 800Hz (bottom figure). This large frequency gap is a first indicator that the assumption of neglecting flexibility for the rigid transient solution has been qualified. Running a flexible transient analysis within ANSYS gives a final confirmation because the displacement results are almost identical compared to the rigid case.

Customer Benefit

A complex assembly can be efficiently investigated due to the option of having both rigid and flexible multibody dynamics within a unique, comfortable GUI of ANSYS® Workbench™.



Figures Courtesy of VDO Automotive AG