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SIMPACK Tips and Tricks – Sensors and Their Definition

When the position or orientation, including velocity and acceleration, needs to be measured, generally one uses sensors. Sensors measure the relative magnitudes between two markers. If one of the markers is the inertial system, then the measurements are said to be absolute.

There are basically two types of sensors:

- The most commonly used type "Position, Velocity, Acceleration i->j" measure the location and orientation of marker "j", relative to marker "i". Velocities and accelerations are also measured.
- The second type, "Position i->j, Orientation j->k, wrt. Ref. Marker", measures the location of the To-Marker, "j", relative to the From-Marker, "i", but the orientation of the connecting line between "j" and "k". This is useful for measuring the orientation of a point-to-point force element or constraint.

Setting the marker "k" equal to marker "i" results in the orientation of the connecting line between the From- and To-Marker.

REFERENCE MARKER

With both sensors, a reference marker may be entered. All measurements are given with respect to the reference marker's co-ordinate system (Picture 1). Please Note: If the reference marker is not entered then, by default, the measurements will be given in the Body Fixed Reference Frame (BFRF) of the From-Body. Therefore changing the orientation of marker "i" will not affect the results unless the reference marker is set (Picture 2).

ANIMATIONS

The automatically predefined sensors, one for each body, are used for defining the motion of primitive ensembles, necessary for animations, and therefore can not be modified. They do not measure relative to the BFRFs of the individual bodies but rather with respect to the inertial system, Isys. Ensembles automatically generated for animating point-to-point springs are coupled with sensors which use the additional orientation marker "k". Once the motion and scaling of ensembles is fully understood, a virtually limitless number of visualization possibilities exist, e.g. bellowing airsprings, representing torque forces, etc.

FORCE ELEMENTS

Kinematic measurements are not only available by way of sensors but also by output values of force elements. Practically all required values of force elements are directly obtainable from the output values. For example, if one wants to plot a spring's force as a function of the spring's length, it is recommended to use the output values of the individual force element as nearly every desired output value is readily available.

Please note: The vast majority of output values are in the From-Marker reference system, "Mi", but quite frequently there are also values given in the From-Body reference system, "Ri" (Please see – Force Elements, SIMPACK documentation).

CONTROL ELEMENTS

Control elements offer a wide range of additional sensor functionality. For example the "AQ-Acceleration Sensor" which includes the gravitational acceleration component necessary for passenger comfort analyses.

FURTHER POSSIBILITIES

For particularly complex measurement situations, function expressions may be used in combination with sensors. All kinematic measurements are available within function expressions (please see - Expressions, SIMPACK documentation). As with sensors, a reference marker should always be entered when using function expressions. Within expressions, various measurements can be easily coupled, for example for averages or differences. The results can be plotted, by using a Y-Output vector or a results element, or can be used for other purposes such as within a control sensor or even another function expression.
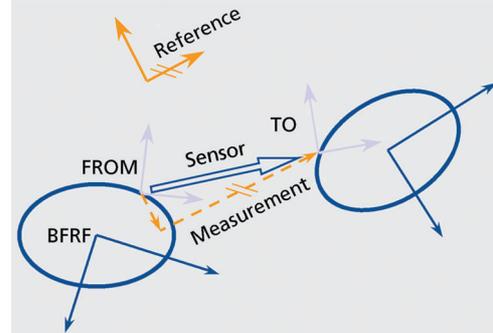
Sensor of First Type Using a Reference Marker
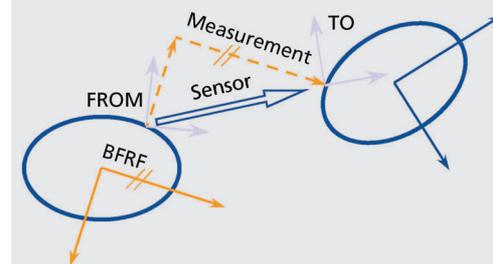
Sensor of First Type without Reference Marker, by Default Using FROM BFRF as Reference
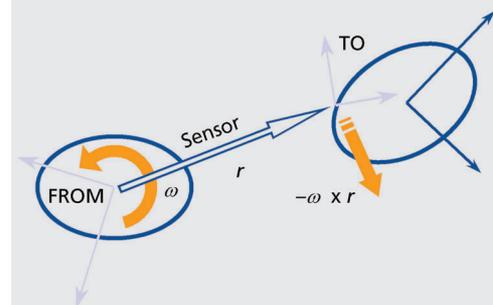
When the FROM Body Rotates, its Rotation ω is Taken into Account, Leading to a Tangential Velocity Component – ω x r in the Sensor Measurement. This Applies also to Accelerations.