

SIMPACK Tips and Tricks - Expressions - Part II

In the previous SIMPACK News the 'Expressions' modelling element was introduced along with some usage examples. This article shows some of the pitfalls that you can fall into and explains the difference between expressions and User Routines.

PITFALL CALCULATION ORDER

Expressions are first evaluated when required. For example Force Element A uses an Expression that reads-in the Output Values of an another Force Element, B. If Force Element A was defined before B, i.e. appears earlier in the Force Element list, then the force calculation for A will run into problems. The Output Values of Force Element B will not have been calculated when A tries to read them in.

In this example the old value from the last call of the Element will be used. This can cause particular problems when the last integration step was outside of the solver tolerance and therefore rejected. This can lead to a value being used which is completely wrong. Some Force Elements, e.g. friction elements read-in Output Values from other Force Elements directly. These Force Elements are calculated internally so that the correct, i.e. the current, value is always used.

PITFALL TIME EXCITATIONS

It is possible to define Time Excitations using an Expression (type 12). It is also possible to control the motion of Moved Markers using Time Excitations, without the need for Rheonomic Joints. Time Excitations can also be used, that read-in an Expression, which then is used to control either a Rheonomic Joint or Moved Marker. The only input that the Expression should read-in is the simulation time.

This is due to the calculation order of the modelling elements in the solver. The solver calculates first the Time Excitations, then the Kinematics (Joints and Markers), the forces in the Force elements and then the Constraints, see figure 1. As soon as the forces in

the Force Elements are available then SIMPACK has the accelerations of the Bodies.

When a Rheonomic Joint reads-in a Time Excitation defined by an Expression, which in turn uses data from other elements, then the Expression will be calculated first. The Expression will therefore read-in the old value from the previous call (which is often no longer valid).

WHEN DOES ONE NEED USER ROUTINES?

Expressions offer a lot of possibilities, but User Routines offer even more. It is possible to define variables and save the calculated values to the buffer. Force Elements and Markers can generate additional states which are then used by the integrator. Root functions can also be defined for Force Elements which stops the integrator at the exact point at which the force law changes. User Routines are normally clearer to understand than an Expression when modelling complicated force laws or laws defining motion. In addition the User Elements have enterable parameters and can be used several times within a model. Expressions have to be defined new for each element in which they are used.

However, for the definition of a specific force law, a complicated excitation or the average of two kinematic measurements an Expression would be a good choice.

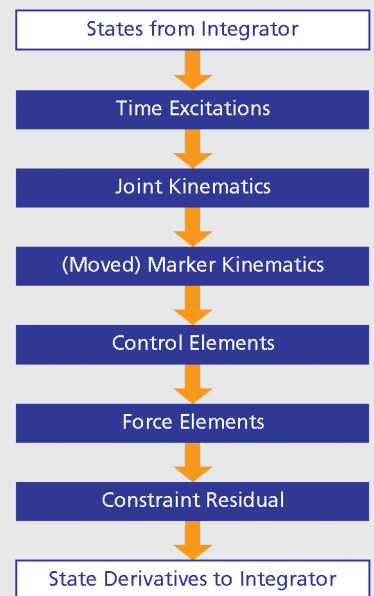


Figure 1 Element Calculation Sequence
(For More Information See ADDF:14.1 in the SIMPACK Documentation)