RECURDYN

Checklist for Improving Simulation Results / Speed

Body	
Check if there is any body whose mass is relatively too small.	If the difference between the masses of the bodies in a model is too big, it can cause numerical instability. The increased time of convergence for each time step can slow the simulation speed. For example, sometimes a dummy body exists which is only used as a "placeholder". In this case, users tend to use a very small mass for the dummy body (such as ten orders of magnitude smaller than the other bodies). However, to avoid numerical instability, it is recommended to use small mass properties which are closer to the mass properties of the other bodies, such as four orders of magnitude smaller.
Check if there are too many bodies.	If there are more than 100 bodies in a model, but certain subsets of the bodies move together like a single body, connecting the separate bodies using fixed joints can slow the simulation speed. Rather, merge the logical subsets of bodies into a single body using the 'Merge' [Home]-[Tools]-[Merge] command. It is also useful to use the [Use Sparse Solver for MBD] option or the [Use Joint Partitioning] option when a model has many bodies. These options are found at ([Home]-[Model Setting]-[Simulation])
Check if the initial velocity of a body is set correctly. Both translational and rotational velocities should be set together.	When the initial velocity for any degree of freedom in a body is set, the initial translational and rotational velocities for all degrees of freedom should be set. The initial velocities are set from the Body property dialog box.
Check if there is any unintended change in the origin or the orientation of a body at the start simulation due to misaligned joints.	A body that is connected to one or several other bodies with joints that is moved after the joints are created will snap back to the original position at the start of a simulation unless the user realigns the joint markers by using the "Copy Base to Action" or "Copy Action to Base" buttons in the joint properties dialog box. Please check for misaligned joints before simulation. This can be checked quickly using Pre Analysis and reviewed the section on Constraint Violations.

Contact	
Reduce the Maximum Step Size Factor of the contact	The default value of a contact's Maximum Step Size Factor is 1-20 depending on the contact type. This value reduces the integrator step size in the solver when contact occurs in order to improve the contact accuracy for impacts. For example, if the value is 10, the step size is reduced by a factor of 10 when contact occurs. However, in many cases where the contact is steady and not a significant impact, the simulation works well (accurate results and fast) with a value of 1. The best practice is to check the integration step that occurs during the simulation and decide if that step size needs to be reduced or not.
Check if the Max Penetration is too big or too small.	If the Max Penetration of a contact is too big or too small, the contact result can be incorrect and/or the simulation can run slowly. If the Max Penetration is too small, it is possible that the contact doesn't occur because the contact "gives up" when the penetration exceeds the Max Penetration value, and this can happen before a sufficient contact force develops. Some contacts have a default Max Penetration value of 10mm, which could be appropriate for large off-highway vehicles on dirt but the value should be reduced for smaller assemblies and stiffer contacts. A value that is too big can yield unexpected results because the search volume is too large. The best practice is to set the Max Penetration value to be 3x-10x the amount of actual penetration that would occur if the model is running properly.
Check if the Spring Coefficient (Stiffness) of the contact is set appropriately.	The bigger the Spring Coefficient (Stiffness) is, the bigger the contact force that can occur from a small penetration. A stiffness coefficient that is too large can cause numerical instability and slow the simulation speed. It is useful to consider that regardless of the stiffness, penetration will occur in the contact until the proper reaction force is achieved. If the size of the stiffness doesn't affect the simulation result (typically true unless the force curve of an impact is being studied), it is recommended to reduce the stiffness by a factor of 10 to increase the numerical stability and simulation performance.

Check if there is any initial interference between bodies which have a contact defined between them.	If there is any initial interference between bodies which have a contact defined between them, the simulation result can be incorrect or the simulation speed can be slow. Frequently, when an external CAD file is imported, invisible interferences exist. When the contact is defined, please check the interference between bodies and move the body positions appropriately. The interference checking command at [Home]-[Measure]-[Interference] is very useful to find out the interference between 2 bodies.
Check if the normal direction of the contact is set correctly.	The normal direction of a contact must be set to the direction in which the contact occurs. The direction can be previewed from the 'Preview' button of the [Contact] dialog box. If the direction is reversed the solver may interpret a large initial penetration in the contact.

Others	
Force **Check if the stiffness of the bushing force is set appropriately.**	The bigger the Stiffness of the bushing force is, the bigger the force that can occur from a small displacement. This can cause numerical instability and slow the simulation. It is useful to consider that regardless of the stiffness, displacement in the bushing will occur until the proper reaction force is achieved. As long as the size of the stiffness doesn't affect the simulation result, it is recommended to reduce the stiffness by a factor of 10 to increase the numerical stability and simulation performance.
Joint **Check if there are too many joints.**	When there are more than 100 joints, using the [Use Joint Partitioning] option can improve the simulation speed. This option can be found at ([Home]-[Model Setting]-[Simulation]).
Solver **Check if the Maximum Time Step in the Parameter tab of the Dynamic /Kinematics Analysis dialog box is set appropriately.**	If the Maximum Time Step is too big the simulation result can be incorrect even if the simulation finishes without giving any error messages. Accurate simulation results occur when the integration step size that occurs during the simulation is appropriate to the speed of the dynamic events that are being modeled. Models that include flexible bodies or have high stiffnesses relative to body mass will tend to run with integration step sizes that are sufficiently small (for simulations of events that are 10 or less seconds in duration, a step size in the range of 1e-4 secs down to 1e-7 secs is recommended). If the step size is larger than 1e-4 you may want to consider reducing the Maximum Time Step as needed to keep the integrator step size in the suggested range. Please keep in mind that a smaller max step size can slow the simulation speed.
Expression **Use a sufficiently large time duration to transition the values in a Step function.**	A Step function is the recommended method for transitioning from one value to another within an Expression. The Step function is inherently smooth, but if the time duration of the transition is too small the value can change radically and cause a numerical instability which can slow the simulation. Please check that the time duration of the transition is reasonable, considering that transitions in physical systems tend to require a noticeable amount of time.
Expression **Use a Step Function rather than an IF function.**	An IF condition is often used in an Expression. However, since this is a discontinuous change, it can cause a numerical instability which can slow down the simulation. Using a continuous change, if possible, can improve the stability and simulation speed. For example, STEP(time,1,1,1.1,2) is more stable than IF(time-1:1,1,2).
Expression **Check if there is any radical change of a value.**	The radical change of a force or motion can cause numerical instability. For example, using a Step function or an IF function which causes a rapid change of a value, or using a stiffness which is too big, can cause simulation failure or poor performance. In this case, the function or parameters either need to be adjusted to avoid the radical change of the value or use a smaller Maximum Time Step in the Parameter tab of the Dynamic/Kinematics Analysis dialog box.
Friction **Check if the threshold velocity of a friction parameter is set appropriately.**	The Threshold Velocities in the friction definition are used to distinguish between zero friction and static friction, and static friction and dynamic friction. When the 'Static Threshold Velocity' and 'Dynamic Threshold Velocity' parameters of a joint friction or a contact friction are too small and/or too close in value, it sometimes slows the simulation speed. If stiction is not important, increasing the Static Threshold Velocity can improve the simulation speed. Note that the default threshold velocities for some contacts are quite large (100mm and 150mm). It can be reasonable to reduce these values to 10mm and 15mm or even 1mm and 1.5 mm, but make these reductions incrementally and check whether or not the lower values have caused a significant slowing of the simulation.

* For More information, contact our MotionPort support team **support@motionport.com**