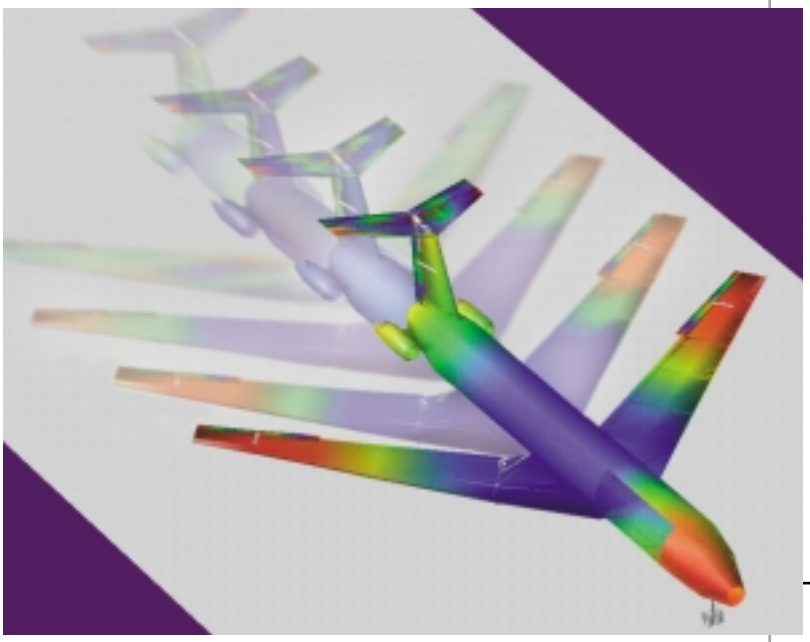
ADAMS/Flex

INTEGRATING SYSTEM-LEVEL MOTION SIMULATION AND COMPONENT-LEVEL FEA TO IMPROVE THE ACCURACY OF YOUR VIRTUAL PROTOTYPE SIMULATIONS



If your engineering team designs and tests mechanical systems containing flexible as well as rigid bodies, ADAMS/Flex can be an essential tool for you. This optional add-on module to our MSC.ADAMS Full Simulation Package allows easy exchange of data between MSC.ADAMS and your preferred finite element analysis (FEA) software.

With the help of ADAMS/Flex, you can incorporate the components you have created in FEA within your MSC.ADAMS simulations to see how full-system performance is affected by having these flexible bodies within your complete mechanism design. ADAMS/Flex also lets you use the results of your MSC.ADAMS simulations to provide accurate loads and flexible-structure displacement data to FEA for studying the effects of motion and forces on individual mechanism components.

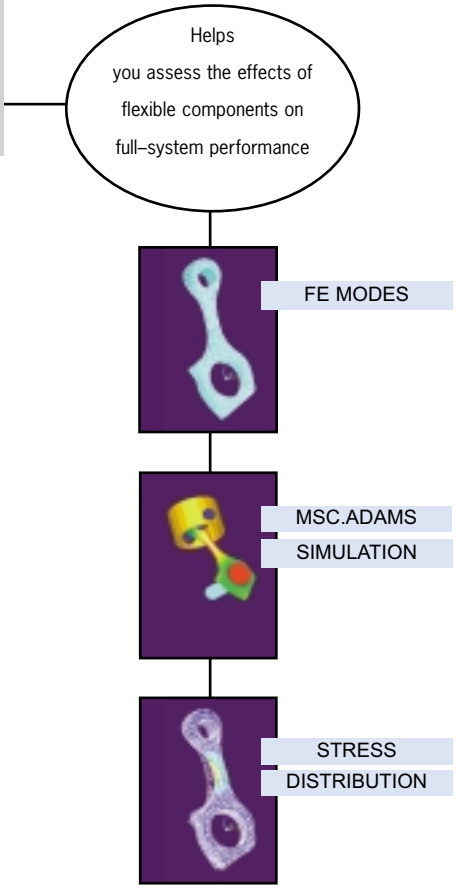
By coupling motion simulation and FEA in this way, ADAMS/Flex can help you improve the accuracy of your full-system simulations and bring you closer to true system-level design and engineering.

PRODUCT LINE

MSC.ADAMS
Extension Product

BENEFITS

- Greatly simplifies the modeling of mechanisms containing flexible components
- Helps assure that interaction between the component and the complete mechanical system is accurately modeled
- Allows fast simulations with no overhead from insignificant or inactive modes
- Reduces numerical integration effort by keeping inactive high-frequency response from adversely affecting solutions
- Helps you interpret simulation results and gain insight into the model's characteristics
- Verifies flexible-body data and modal content, and lets you investigate interaction with control systems
- Provides full access to the powerful analysis capabilities of the MSC.ADAMS Full Simulation Package



MSC SOFTWARE
SIMULATING REALITY

APPLICATIONS

System Design Analysis

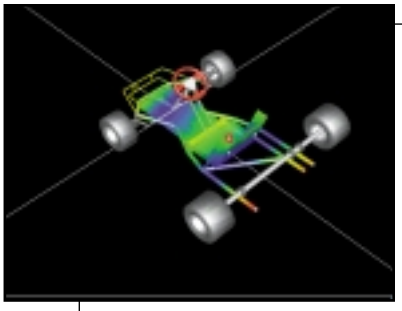
No engineering team designing complex precision mechanisms can afford to overlook the ways in which component flexibility can influence overall mechanism performance. Consider, for example, how connecting-rod flexibility in a multicylinder engine can affect load variation on bearings, vibration, and fatigue resistance.

Component Design Analysis

An MSC.ADAMS simulation of a mechanism containing only rigid bodies can provide useful loads data for component designers. But that may be just part of the complete picture, as component flexibility can have a significant impact on load distribution. ADAMS/Flex improves the reliability of loads prediction by supplying your FEA software with complete time histories of component deformations. Having this data can give you added confidence in your subsequent analyses of stress, fatigue, and other component variables.

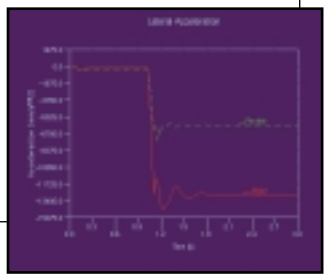
FLEXIBLE VEHICLE SUSPENSION

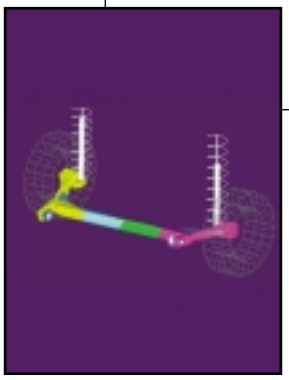
Here is another way that ADAMS/Flex can help you integrate the worlds of FEA and motion simulation. A vehicle suspension component undergoing large, nonlinear deformations can be modeled as an assembly of linear flexible bodies derived from ADAMS/Flex modal representations and subjected to extreme torsional loads.



FLEXIBLE GO-KART

Including a flexible frame in this go-kart design dramatically changes the dynamics of the full vehicle. A rigid frame approximation leads to 100% error in estimating lateral acceleration. The vehicle with a rigid frame follows a smaller-radius turn. In this case, accounting for the flexible frame is the most important element in accurately simulating full-vehicle dynamics. This gives you an idea of why ADAMS/Flex can be such a critical tool for full-system simulation.





FLEXIBLE AIRCRAFT

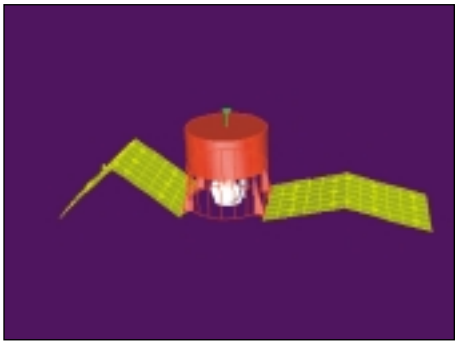
The simulation below shows the general effects of flexibility on an airframe, with special emphasis on loading at control-surface hinges and landing gear attachment points. The model contains seven flexible bodies in all. These images show deformation contours for all seven of these components during the landing event.

As anticipated, the dynamic load histories at points of interest are significantly affected by the addition of flexibility. For example, the landing-gear trunnion loads show only slight differences on initial impact between the rigid and flexible versions of the problem, but dramatic differences in subsequent load excursions due to strain energy being absorbed by the flexible bodies.

These effects would be lost if flexibility were not included, and there would be a significant impact on fatigue estimations for the model's components.

FLEXIBLE SATELLITE WITH AUTOMATIC CONTROLS

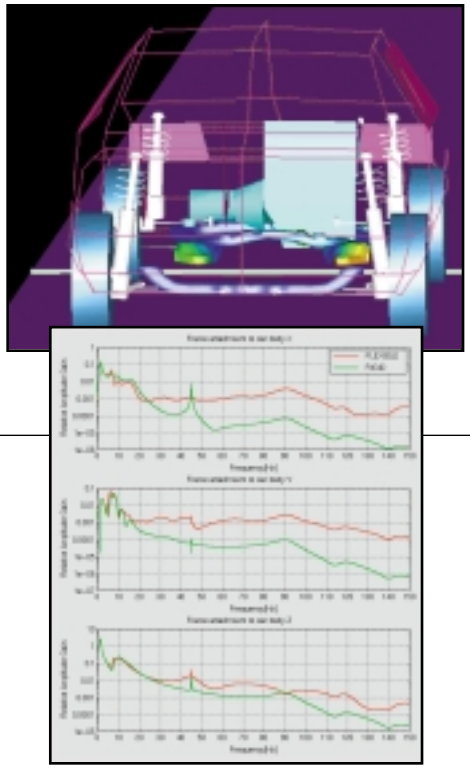
With ADAMS/Flex, you can combine flexibility effects with standard closed-loop dynamic control systems. In this example, an automatic control system model actuates a series of internal momentum wheels in order to stabilize the satellite's orientation during the deployment of the flexible solar panels. Without considering flexibility, there would be an adverse impact on control system design.



FLEXIBLE VEHICLE FRAME AND CHASSIS

In this vehicle simulation, high–frequency input signals are transferred through the flexible frame to the vehicle's chassis. Multiple connections between rigid and flexible bodies are made via standard joints or complex nonlinear components (rubber bushings).

Two flexible bodies are present in the system. The effects of flexibility can be easily checked in frequency domain Bode plots.



COMPONENT MODE SYNTHESIS

ADAMS/Flex supports Component Mode Synthesis (CMS), so you can attach joints, constraints, and other rigid components to the flexible bodies you have created in FEA.

This can provide you with many useful advantages:

- A linear superposition of mode shapes captures rich dynamic behavior with few degrees of freedom.
- An assembly of modal flexible bodies captures large deformations and centrifugal stiffening effects.
- Correct make-up of the modeshape basis tailors the body for use in a particular frequency range.
- Damping can be conveniently and intuitively controlled as a ratio of critical damping for individual modes.
- You get the ability to accommodate experimental modal data.

INTEGRATION

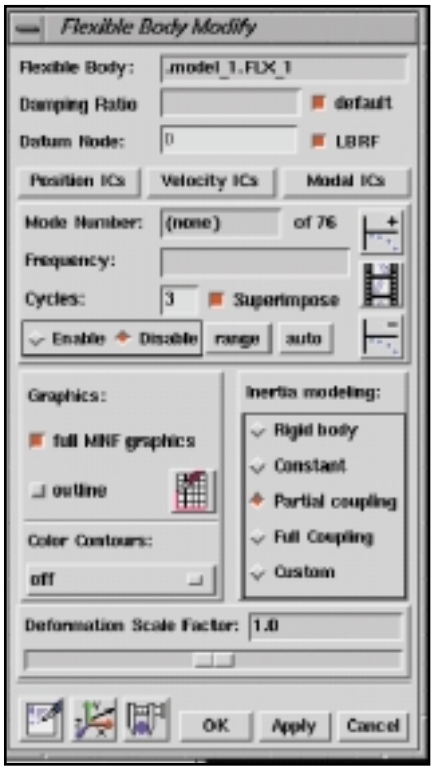
ADAMS/Flex's interface makes it easy to directly transfer data to and from these leading FEA software packages:

- MSC.NASTRAN
- ABAQUS from Hibbitt, Karlsson & Sorensen, Inc.
- ANSYS from ANSYS, Inc.
- I-DEAS Model Solution from Structural Dynamics Research Corp.

Our easy, intuitive graphical user interface conforms to industry-standard conventions— Motif and Windows — so if you are already familiar with other leading computer-aided engineering tools, you can quickly become productive with ADAMS/Flex. The toolbox, icons, menus, and dialog boxes can be easily customized to your specific application needs.

EASY-TO-USE INTERFACE

- View FE mesh within your full–system assembly to manage the flexible body's attachments and attributes
- Draw, animate, enable, or disable a component's modes
- Automatically disable component modes contributing small amounts of strain energy
- Scale deformation to enhance visual feedback
- Precalculate inertia invariants
- Represent deformation in color contours, with complete control over deformation reference
- Replace flexible-body graphics, if needed, with outline sketches
- Animate component modes, system modes, and simulation results
- Use our powerful plotting capabilities to study the results of your simulation



	FEATURE	FUNCTION	BENEFIT
Ease of Use	Modal neutral-file format provides a self-contained data-transfer mechanism	Allows convenient and robust interdepartmental sharing of flexibility data	Greatly simplifies the modeling of mechanisms containing flexible components
Accuracy	Craig-Bampton component mode synthesis (CMS) with mode-shape orthonormalization and multiple reference frames	Accounts for the local effect of an attachment at the special attachment nodes and accounts for all dynamic stress-stiffening effects	Helps assure that interaction between the component and the complete mechanical system is accurately modeled
Speed	Graphical review and selection of mode shapes for the flexible body	Helps you control modal content	Allows fast simulations with no overhead from insignificant or inactive modes
Robustness	Time-variable modal damping on a mode-by-mode basis	Gives you full control over the component's damping characteristics	Reduces numerical integration effort by keeping inactive high-frequency response from adversely affecting solutions
Communication	Graphical display of flexible–body deformation with optional scaling and color	Provides strong visual feedback for design analysis and refinement	Helps you interpret simulation results and gain insight into the model's characteristics
Linear Analysis	Full support for system-mode computation in ADAMS/Linear	Computes flexible-body participation in system modes	Verifies flexible-body data and modal content, and lets you investigate interaction with control systems
Convenience	Completely supported in any MSC.ADAMS model	Allows you to substitute flexible bodies for rigid bodies where appropriate	Provides full access to the powerful analysis capabilities of the MSC.ADAMS Full Simulation Package

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