Linear Toolkit

Benefits

Linearization is an important tool in understanding the system behavior of a nonlinear system in a given state.

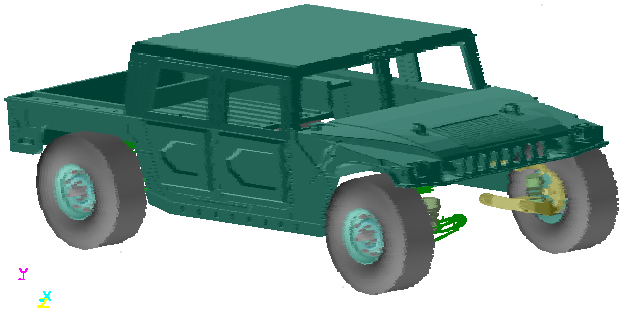
Vibration Analysis at a System Level

- RecurDyn/Linear performs a linearization of the nonlinear RecurDyn model at a given operating state to prepare for an eigenvalue Analysis.
- The natural frequencies (eigenvalues) and and mode shapes (eigenmodes) for the system model are calculated.
- System-level effects include interaction between components of an assembly and their constraints

Support of Control System Design

- A linear plant model can provide the eigenvalues of the linearized equations of motion that are useful in verifying control logic and stability
- The linearized model can also be output in the form of state space matrices (A, B, C and D state matrices) and state variables.
- Linearization of a constrained system includes the effect of algebraic constraint equations and corresponding Lagrange multipliers.

- **Eigenvalues of Humvee Model**



Natural Frequencies	
4th	1.13 Hz
5th	9.22 Hz
6th	13.11 Hz
7th	13.11 Hz
8th	13.82 Hz
9th	13.82 Hz
:	
:	

- **Eigenvectors of Connecting-Rod**

1ST MODE

Frequency 55.69 Hz

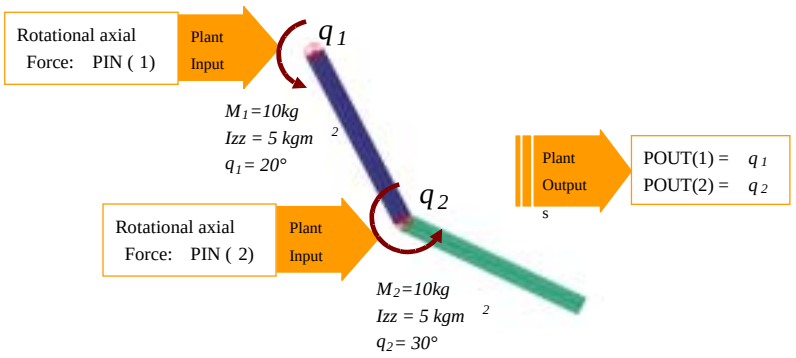
2ND MODE

Frequency 73.15 Hz

Generation of State Space Matrices

- State matrices can be directly imported into control system design packages.
- A state space representation gives the frequency response of the mechanical system
- The ability of feedback controllers to control and observe the model can be verified.

Example: Double pendulum with 2 D.O.F.



STATE VARIABLES

	Name	Direction	Sign
1	Revjoint1	Velocity of ROTATION Z	-
2	Revjoint1	Displacement of ROTATION Z	-
3	Revjoint2	Velocity of ROTATION Z	-
4	Revjoint2	Displacement of ROTATION Z	-

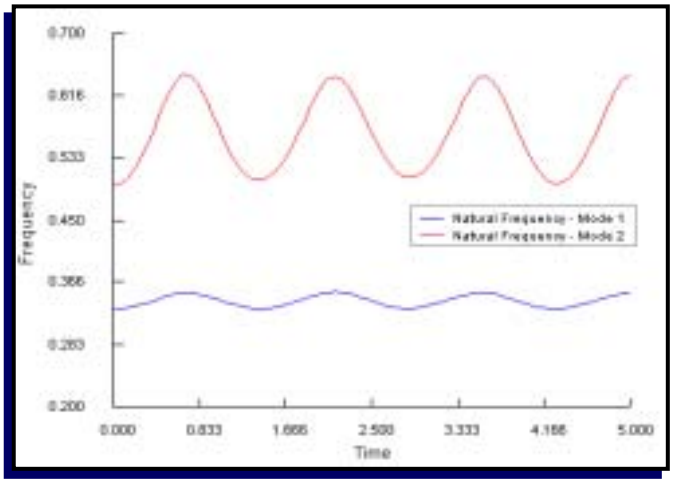
STATE MATRICES

	1	2	3	4
1	0.00026	-6.00210	0.00017	0.74566
2	1.00000	0.00000	0.00000	0.00000
3	-0.00075	8.41975	-0.00026	-6.01465
4	0.00000	0.00000	1.00000	0.00000

	1	2
1	0.06667	-0.10516
2	0.00000	0.00000
3	-0.10516	0.29920
4	0.00000	0.00000

	1	2	3	4
1	0.00000	1.00000	0.00000	0.00000
2	0.00000	0.00000	0.00000	1.00000

	1	2
1	0.00000	0.00000
2	0.00000	0.00000



MotionPort, LLC

A RecurDyn Distributor
Authorized by
FunctionBay, Inc.

Function Bay

3845 Maple Drive, Ypsilanti, MI 48197-3743
Tel : 734-572-9630 info@motionport.com http://www.motionport.com