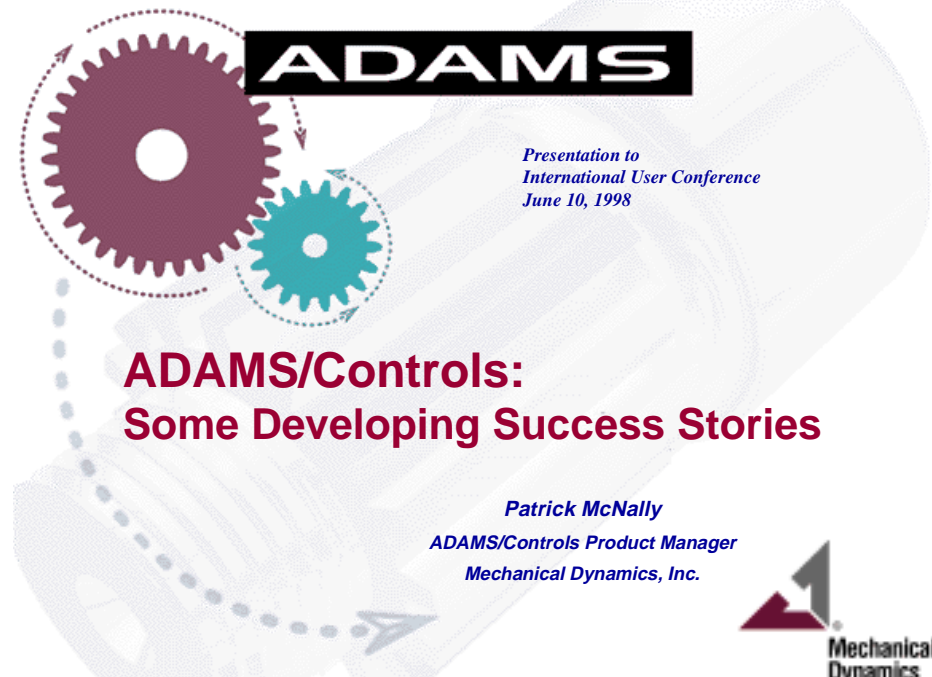


ADAMS/Controls: Some Developing Success Stories




ADAMS

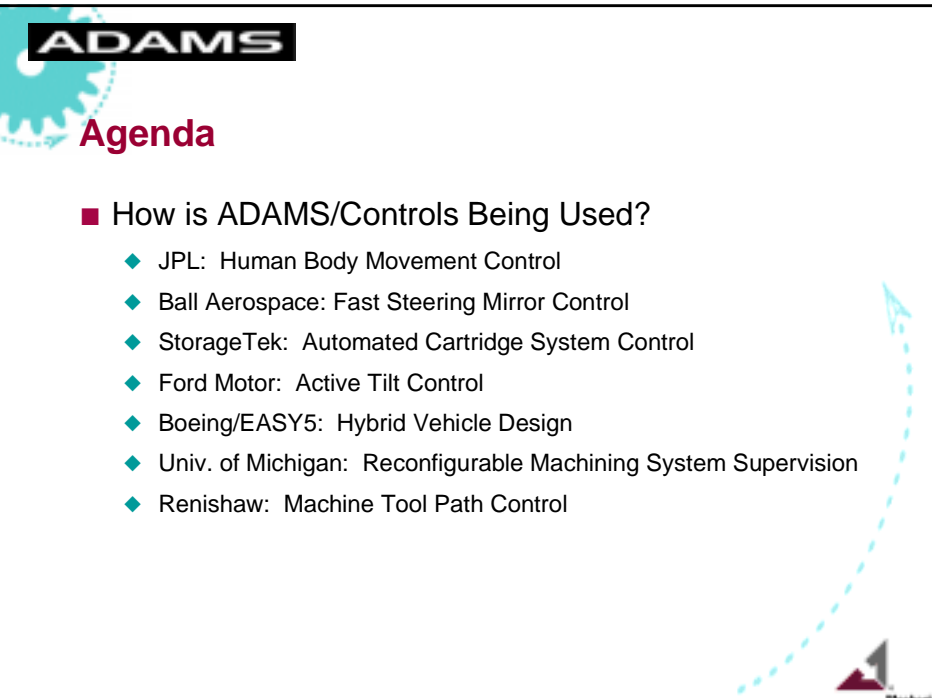
*Presentation to
International User Conference
June 10, 1998*

**ADAMS/Controls:
Some Developing Success Stories**

*Patrick McNally
ADAMS/Controls Product Manager
Mechanical Dynamics, Inc.*




Mechanical
Dynamics



ADAMS

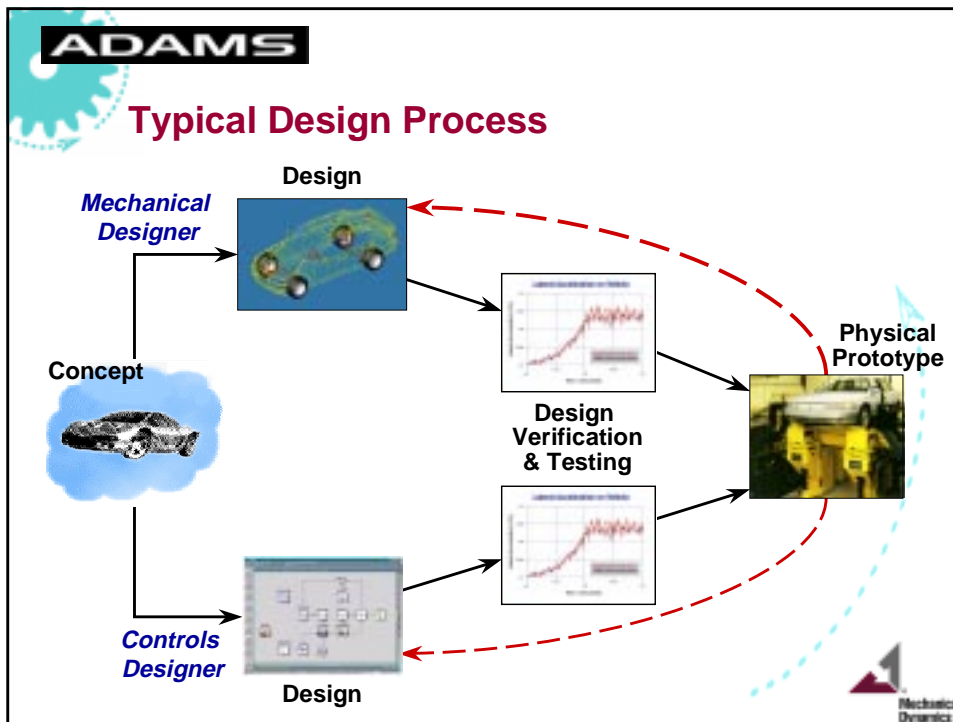
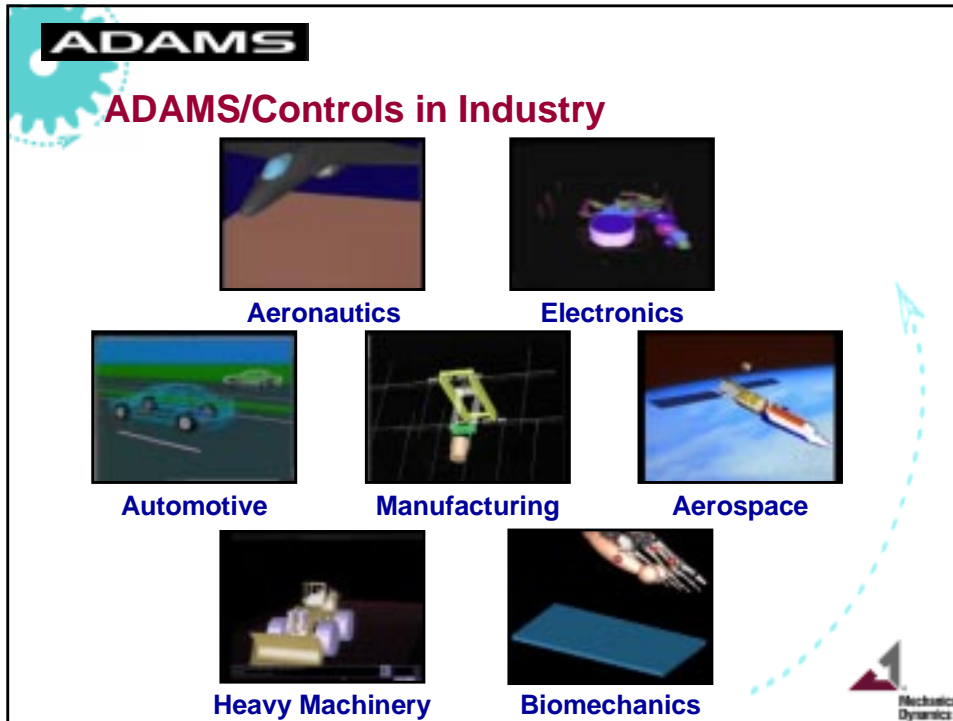
Agenda

- How is ADAMS/Controls Being Used?
 - ◆ JPL: Human Body Movement Control
 - ◆ Ball Aerospace: Fast Steering Mirror Control
 - ◆ StorageTek: Automated Cartridge System Control
 - ◆ Ford Motor: Active Tilt Control
 - ◆ Boeing/EASY5: Hybrid Vehicle Design
 - ◆ Univ. of Michigan: Reconfigurable Machining System Supervision
 - ◆ Renishaw: Machine Tool Path Control

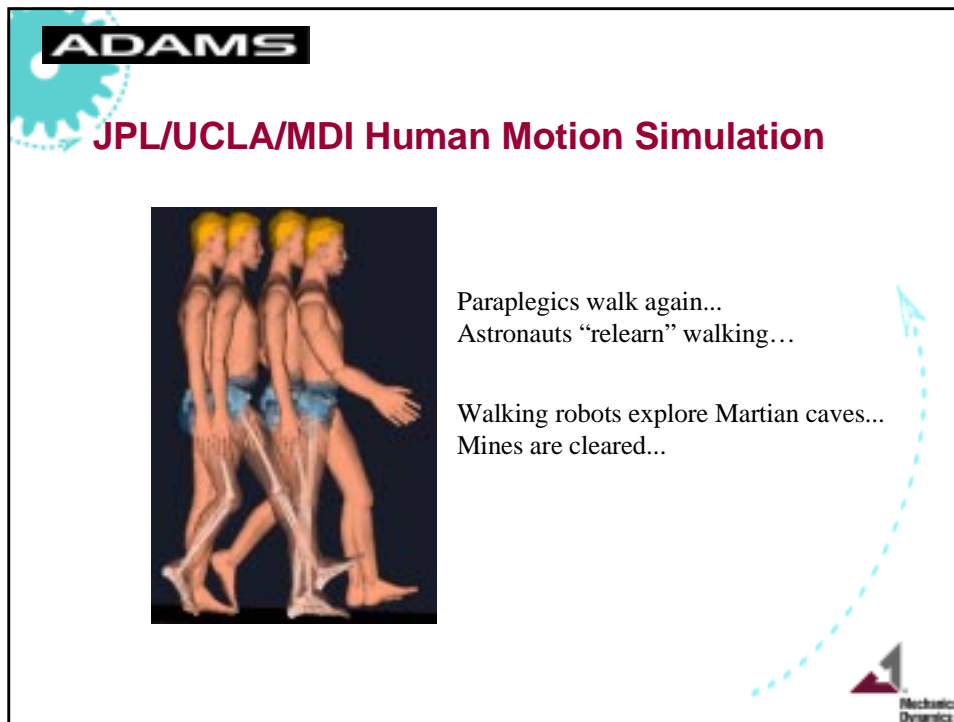
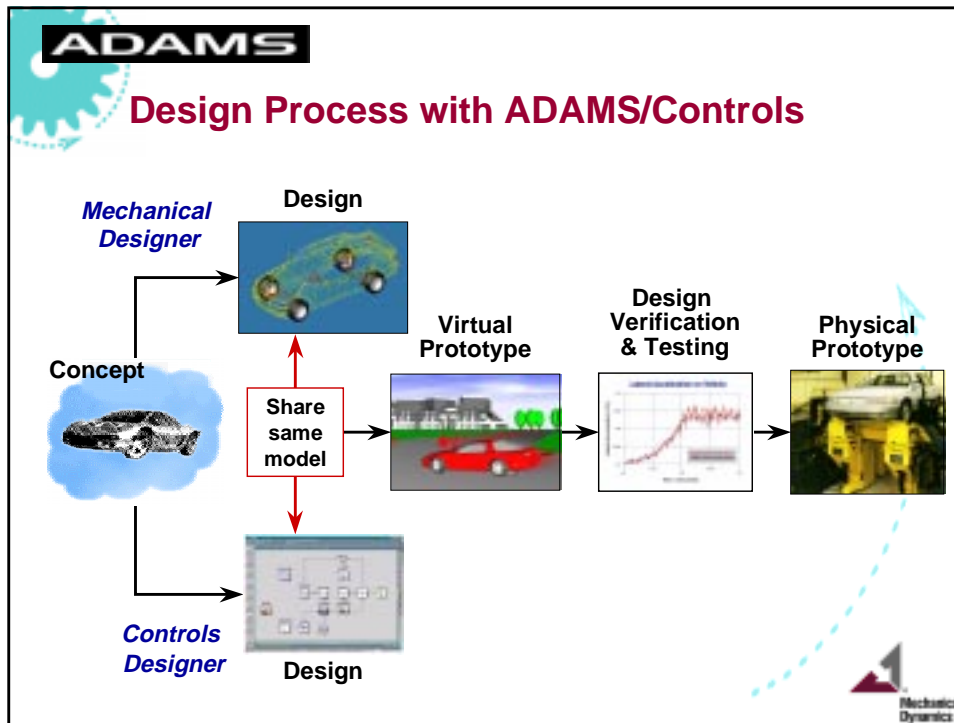


Mechanical
Dynamics

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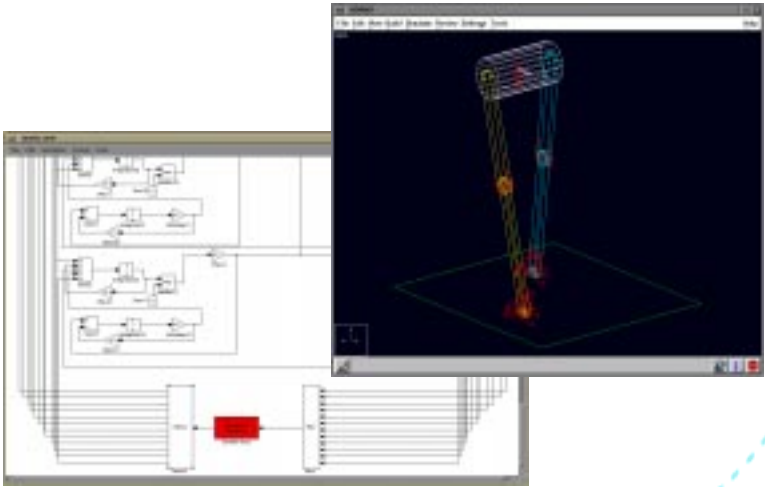
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ADAMS

MATLAB NN Model combined with ADAMS

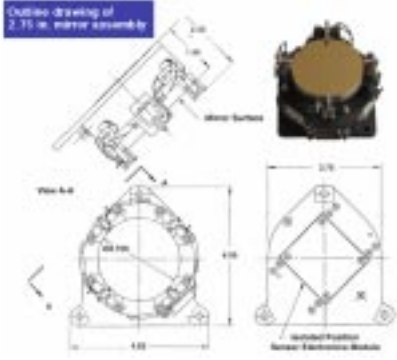


The image displays a software interface for ADAMS. On the left, there is a schematic diagram of a mechanical system with various components and connections. On the right, a 3D rendering shows a mechanical assembly with a cylindrical component at the top, supported by a structure with multiple vertical elements. A dashed blue arrow points from the 3D model towards the bottom right corner.

Mechanical Dynamics

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Ball Aerospace Fast Steering Mirror

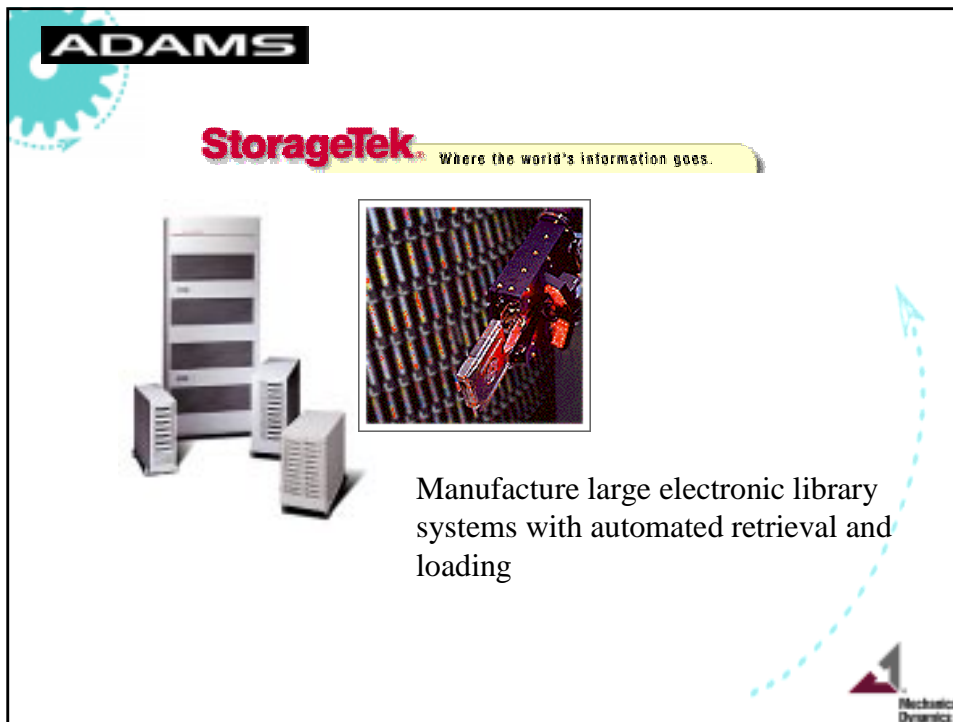
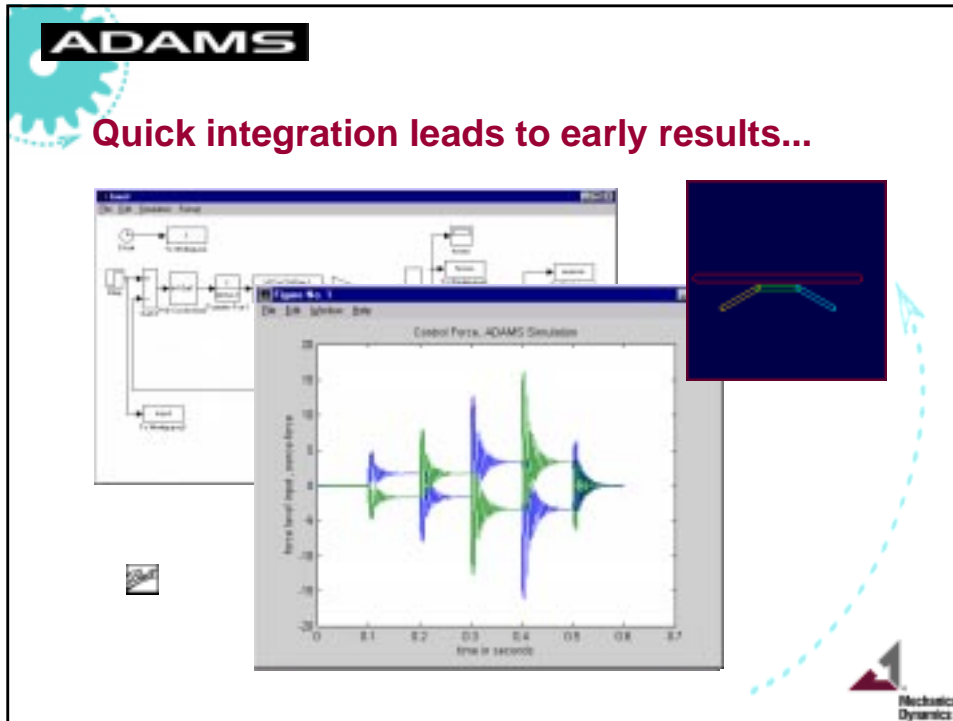


The image shows technical drawings and a photograph of a Ball Aerospace Fast Steering Mirror. The drawings include an 'Outline drawing of 2.75 in. mirror assembly', a 'View A-B' showing a circular mirror with a diameter of 1.00, and a 'Detailed Position Sensor Electronics Module' with a diameter of 0.75. A photograph shows the physical assembly, which is a circular mirror mounted on a complex mechanical structure.

- Patented flexible 2 DOF mount
- Noncontacting sensor system for angular displacement
- 10 mrad step in 11msec, with <math>< 0.5 \mu\text{rad}</math> RMS stability
- Application: industrial instrumentation, astronomy, laser communications, imaging systems, others

Mechanical Dynamics

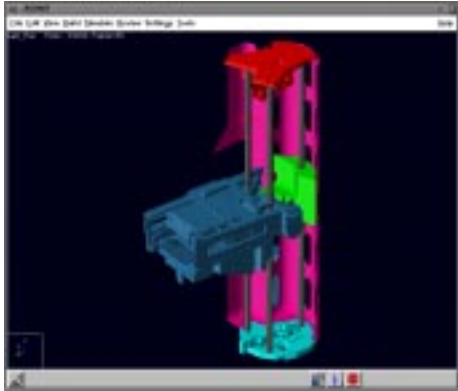
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ADAMS


ADAMS Automatic Cartridge Model accounts for system flexibility...

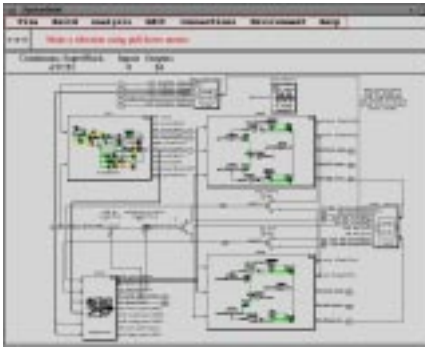


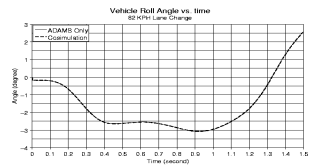
- Used for selecting and loading tape cartridge
- flexible mounting and stiffeners
- belt driven motion
- initial controller developed with rigid model - unstable
- flexible system model verified against test data
- now modify controller to account for flex effects



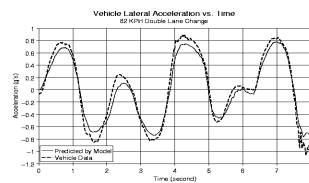
ADAMS

 **COSIMULATION**






Time (seconds)	ADAMS OTR (degrees)	Displacement (degrees)
0.0	0.0	0.0
0.5	-2.5	-2.5
1.0	-3.5	-3.5
1.5	-1.5	-1.5
2.0	1.5	1.5



Time (seconds)	Displacement by Model (g)	Vehicle Data (g)
0.0	0.0	0.0
1.0	0.8	0.8
2.0	-0.8	-0.8
3.0	0.8	0.8
4.0	-0.8	-0.8
5.0	0.8	0.8
6.0	-0.8	-0.8
7.0	0.8	0.8
8.0	0.0	0.0

FORD ATC correlates ADAMS/Controls data with test and ADAMS

See George Villec's paper in the proceedings



ADAMS/Controls: Some Developing Success Stories

ADAMS

ADAMS - EASY5 Hybrid vehicle

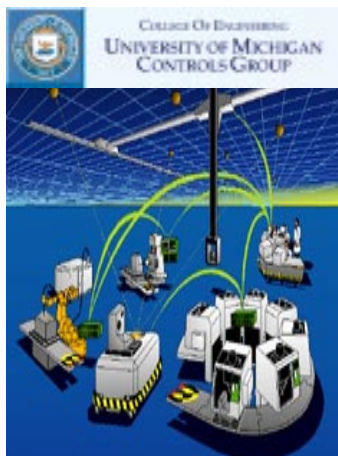


- Strong powertrain-vehicle dynamics coupling
- Test model developed in conjunction with Boeing



ADAMS

Univ. of Michigan: Flexible Manufacturing



- Quickly design and configure a manufacturing system to provide exactly the production capacity and functionality needed
- Readily upgrade with new process technologies and new functions
- Rapidly reconfigure to provide new functionality to produce future products

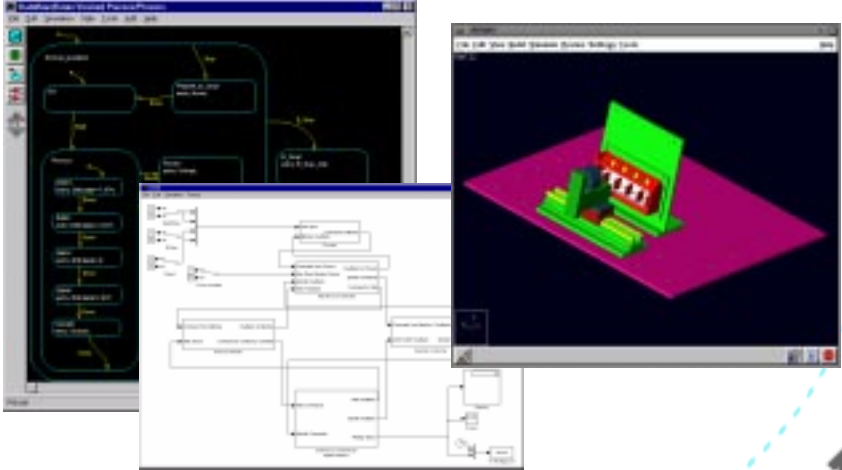


ADAMS/Controls: Some Developing Success Stories

ADAMS

COLLEGE OF ENGINEERING
UNIVERSITY OF MICHIGAN
CONTROLS GROUP

Integration of ADAMS with MATLAB/Stateflow




The image displays a screenshot of the ADAMS software interface. On the left, there is a Stateflow control logic diagram with various nodes and transitions. On the right, a 3D model of a mechanical assembly is shown, consisting of several green and red components mounted on a pink base. The ADAMS logo is in the top left, and the University of Michigan Controls Group logo is in the top right. A dashed blue arrow points from the 3D model towards the bottom right corner.

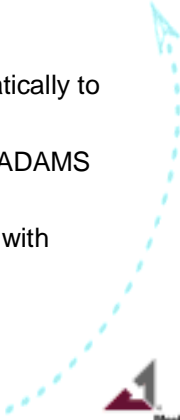
Mechanical Dynamics

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Renishaw PLC



- Command machine tool around arbitrary paths
- design paths in MATLAB
- drive ADAMS model kinematically to design feedforward loop
- design dynamic servo from ADAMS results
- virtual test of final controller with ADAMS model



Mechanical Dynamics

ADAMS/Controls: Some Developing Success Stories

ADAMS

Conclusion

- ADAMS/Controls makes it easy to directly transfer data to and from these leading control system design packages:

MATRIX_x
with SystemBuild



Integrated Systems, Inc.
Sunnyvale, CA

MATLAB
with SIMULINK



The Math Works Inc.
Natick, MA

EASY5



The Boeing Company
Seattle, WA

