ADAMS

ADAMS Dynamic Solution Techniques

- ***Survey of Solution Techniques***
- ***Strategies for Using the ADAMS Integrators***
- ***Future Vision of Solution Techniques***

Mechanical
Dynamics

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Implicit vs. Explicit Methods

- *Explicit methods are easier to integrate and often linear*
- *Implicit methods are stabler and often nonlinear*

Mechanical
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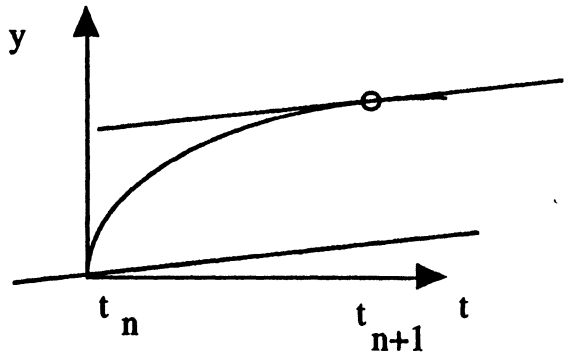
Implicit methods are stabler and often nonlinear

- $y'_{n+1} = f(y_{n+1}, t_{n+1})$



Mechanical Dynamics

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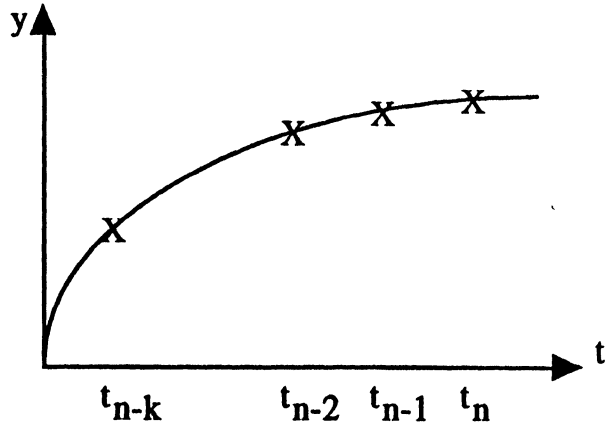
Multistep Methods

- *Use History of Multiple Steps*



Mechanical Dynamics

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ADAMS Uses a PECE Method

- *Predict*
  - *Adams-Bashforth*
  - $y^{(p)} = y_{n-1} + hf(y_{n-1}, t_{n-1})$
- *Evaluate*
  - $f(y^{(p)}, t_n)$

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Best for mechanisms dominated by constraints and small, smooth forces

- *Typically are not numerically stiff.*
- *Example: A satellite in orbit.*

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Differential/Algebraic Equations

- *Systems of DAEs are classified by their INDEX*
- *Problems arise with High Index DAEs and BDFs*

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Pendulum Example

- *1st order equations of motion*
  - $x' = u$
  - $y' = v$
  - $u' = \lambda x$
  - $v' = \lambda y - g$
  - $x^2 + y^2 - L^2 = 0$

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Pendulum Example (cont.)

- Substitute for u', v'
- $x^2\lambda + y^2\lambda - yg + u^2 + v^2 = 0$
- $L^2\lambda - yg + u^2 + v^2 = 0$

- Differentiate constraint again and solve for λ'
  - $\lambda' = (vg - 2\lambda ux - 2v(\lambda y - g))/L^2$
- Thus, the index is three.

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Strategies for Using the ADAMS Integrators

- *Select the proper method.*
- *Select the proper tolerances.*
- *Solve Corrector Difficulties.*

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Select the proper tolerances.

- *Start with ERROR = %Accuracy/(2*# of steps)*
- *Reduce ERROR Until Displacements Converge*
- *Reduce HMAX Until Accelerations Converge*

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Future Vision of Solution Techniques

- *Ultimate Goals*
  - *Automatic Selection of Methods & Parameters*
  - *ADAMS automatically chooses perfect defaults.*
  - *User* can *change everything* optionally.
- *Continually Expand Solution Space*

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ADAMS POWERTRAIN

Chain Drive System

Yeongching Lin, Ph.D.
Sam F. McDonald
Mechanical Dynamics, Inc.
November 15, 1995

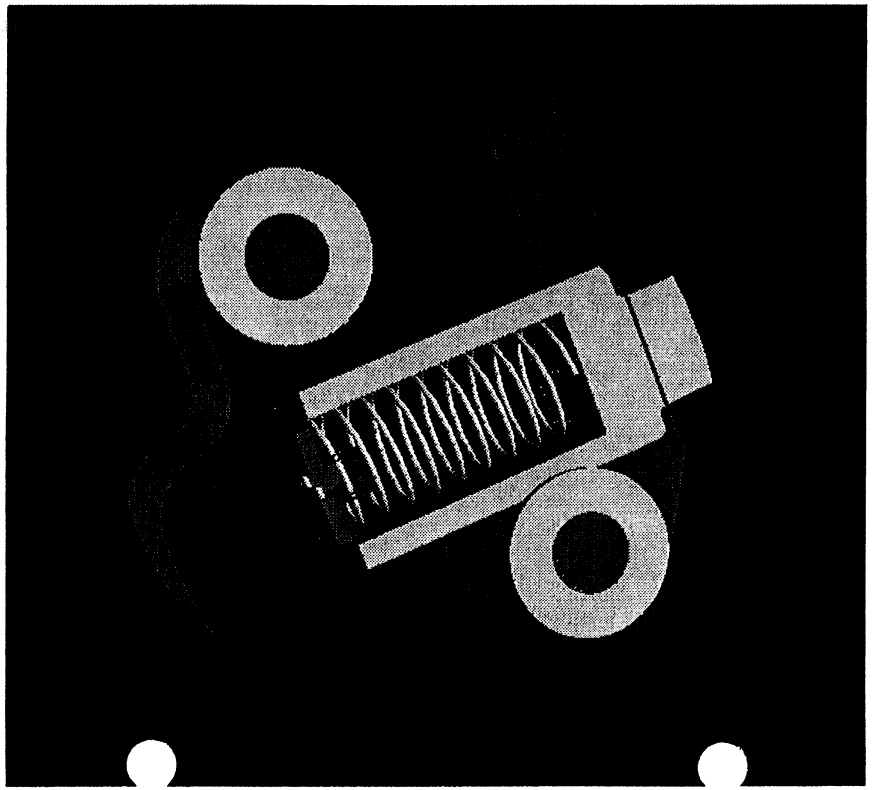
Mechanical

Engine Components

- Hydraulic System
- 2.5L Engine
- 3.5L Engine
- Preprocessor

Hydraulic Tensioner

- Consists of check ball, spring, and fluid
- Predicts back flow
- Parametric model



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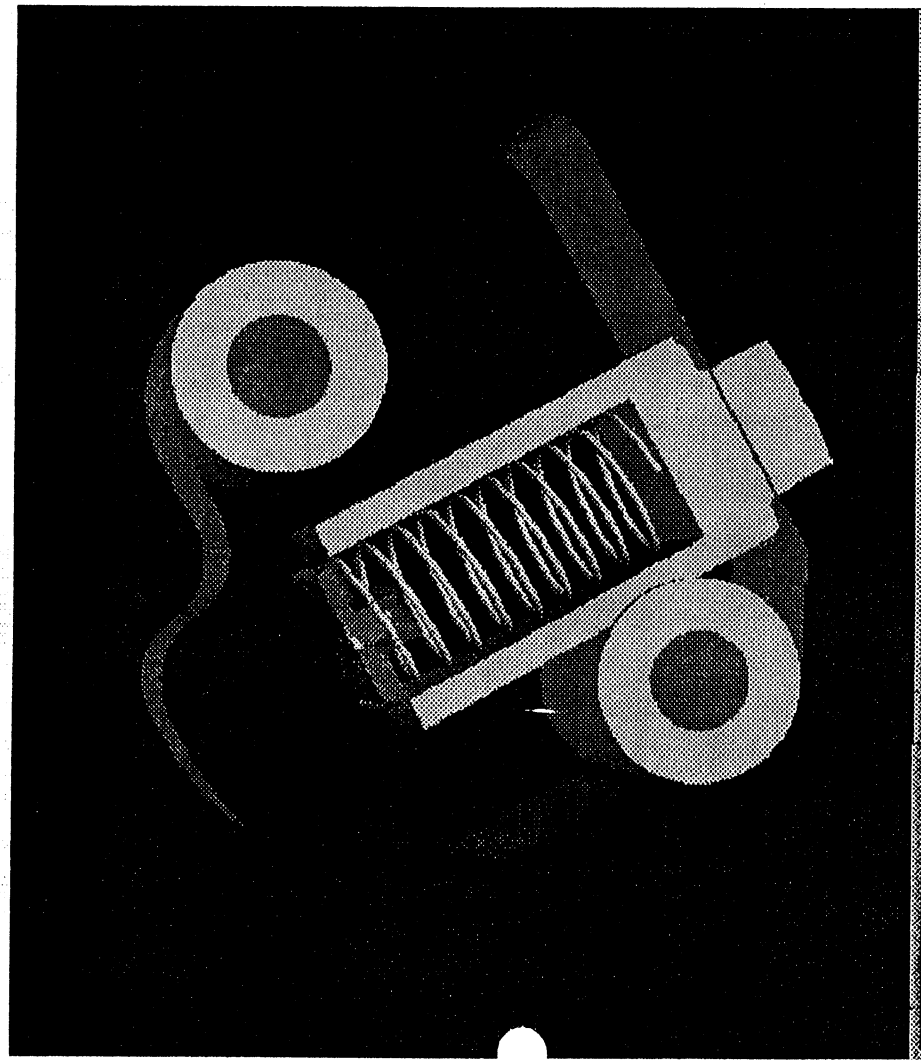
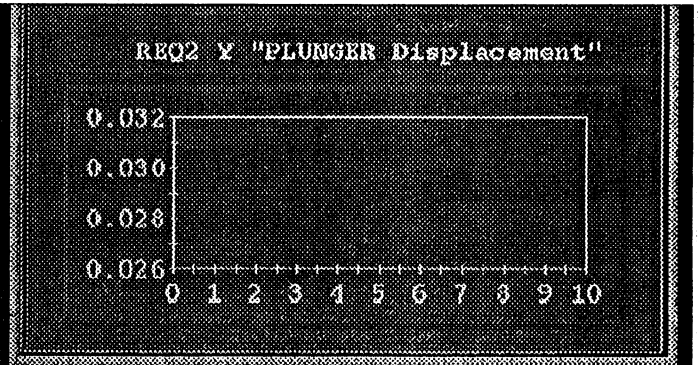
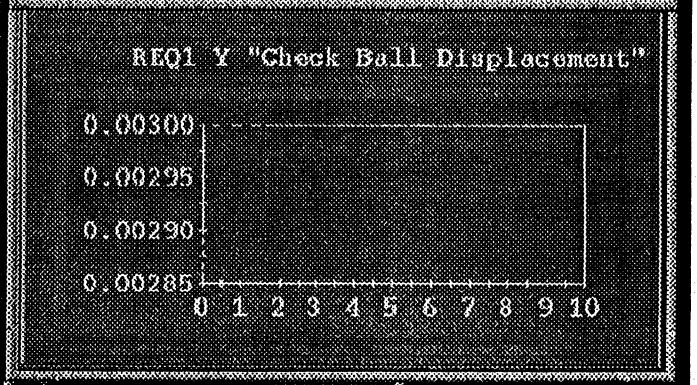
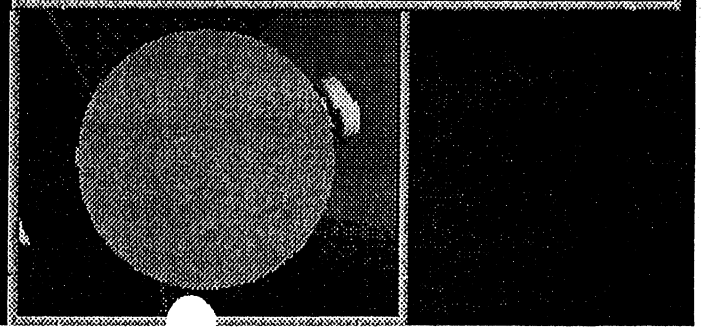
Hydraulic Tensioner









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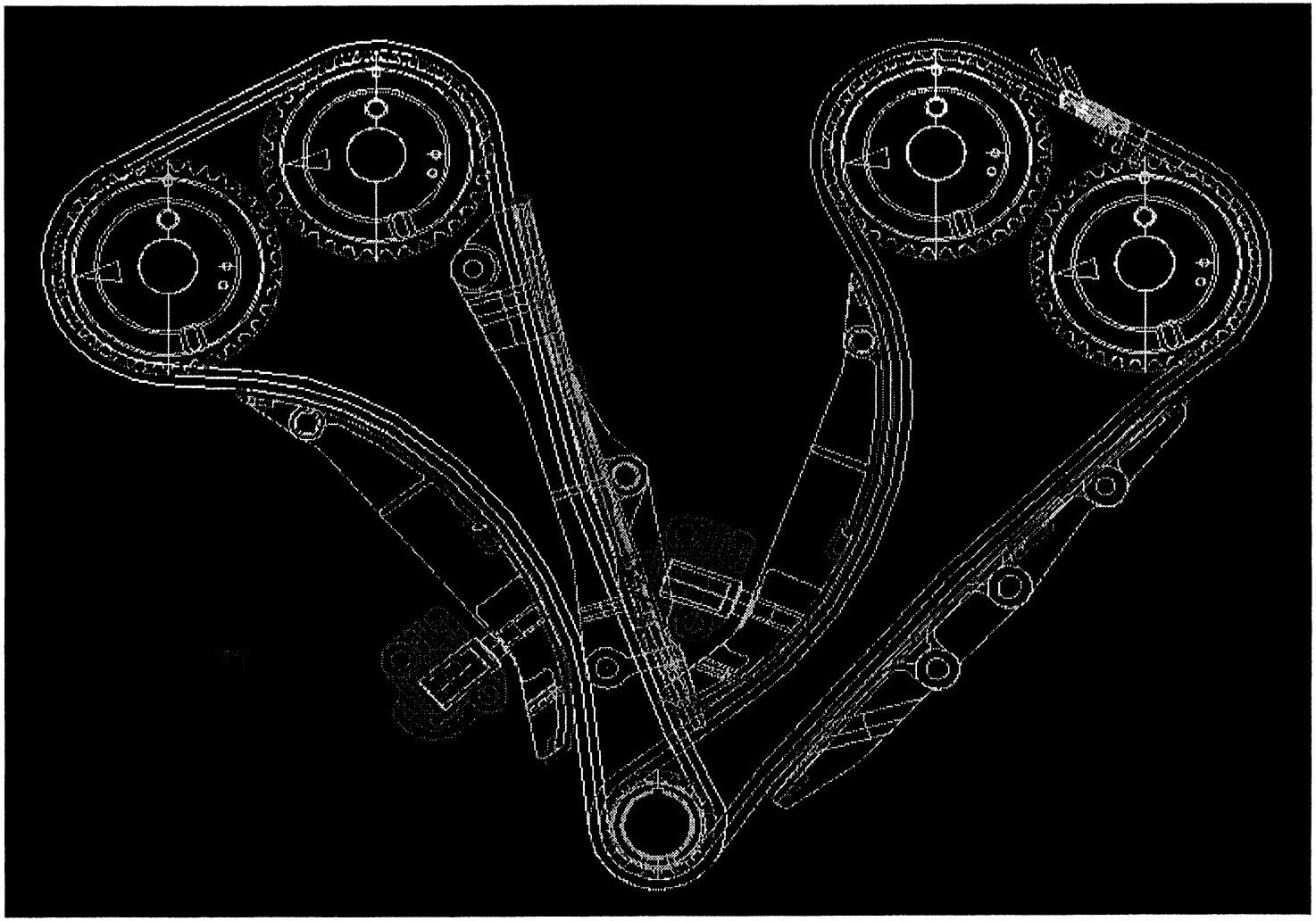
2.5L Engine



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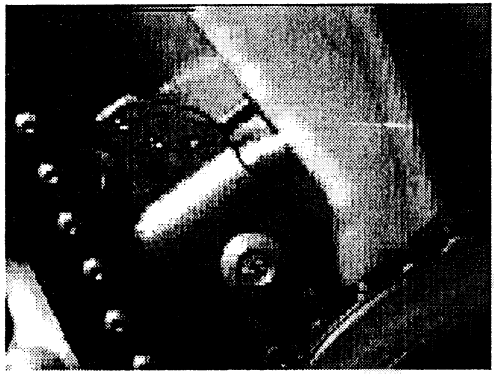
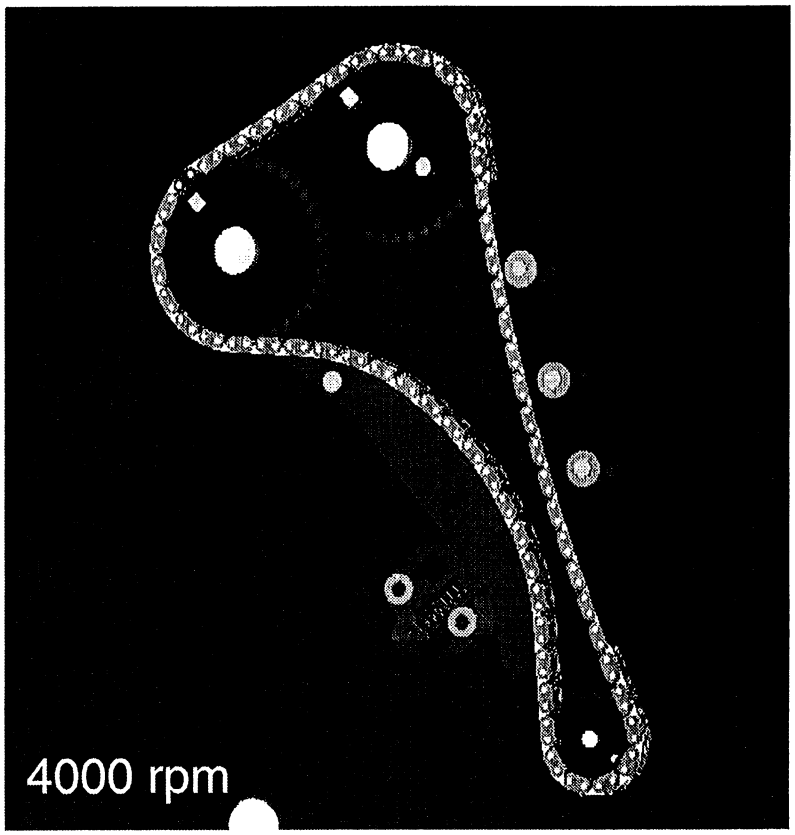
2.5L Engine

- Consists of cam, cam sprocket, chain, chain guide, chain arm, and hydraulic system
- Predicts hydraulic tensioner performance, impact forces, and tension on the chain
- Analyzes transient and dynamic responses





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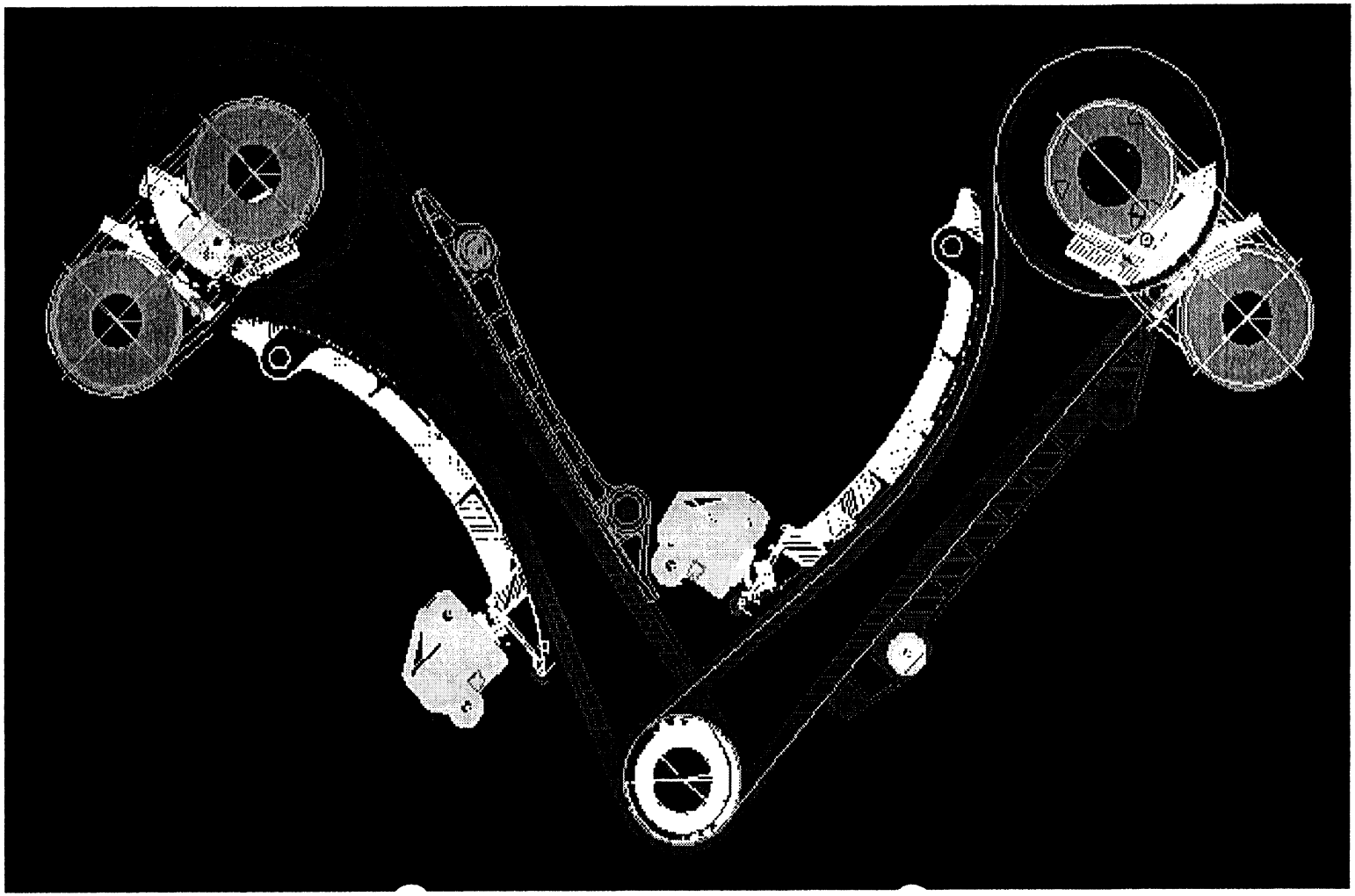
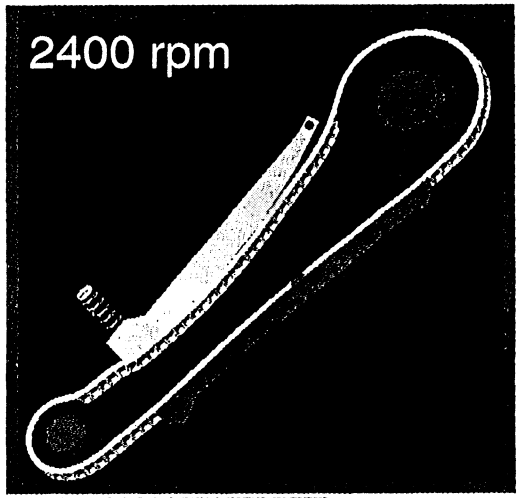
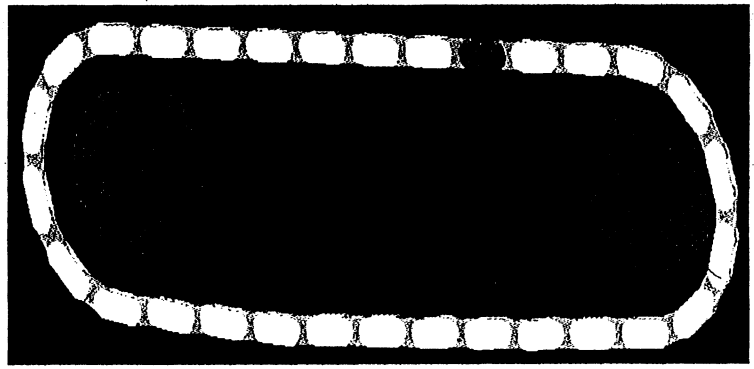
3.5L Engine

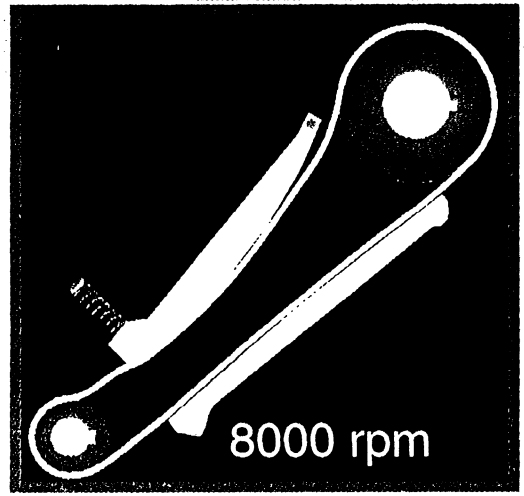


3.5L Engine

- Consists of primary chain drive and secondary chain drive systems
- Analyzes transient and dynamic responses







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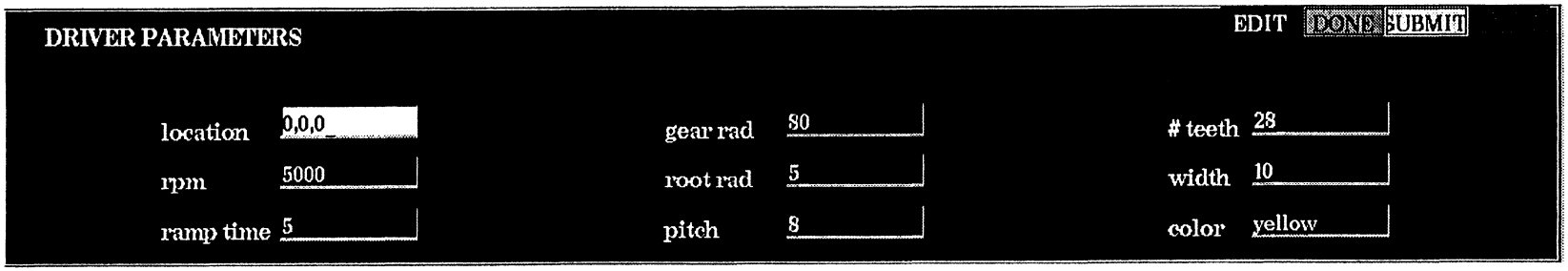
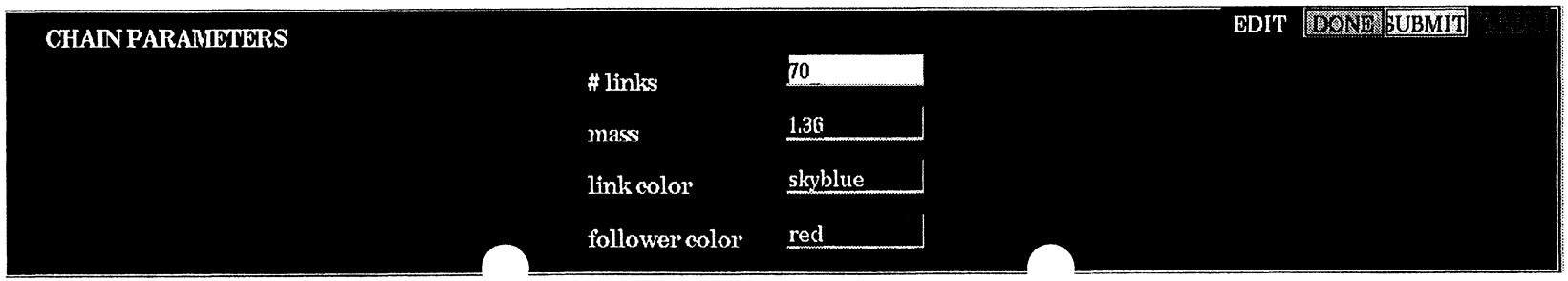
Customized Preprocessor

- Easy–to–use interface for casual users
- Hydraulic and chain systems parameterized
- Automated model creation





Mechanical