Servo Controller Compensation Methods Selection of the Correct Technique for Test Applications
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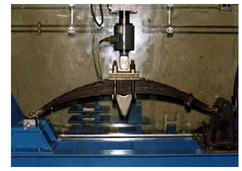
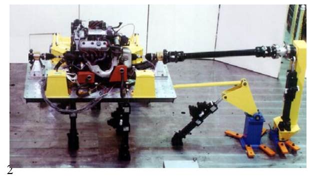
Testing Applications

Basic test types:
- Inertial vs. fixed reacted
- uni-axial vs. multi-axial
- sine, block sine, real time simulation





Testing Applications

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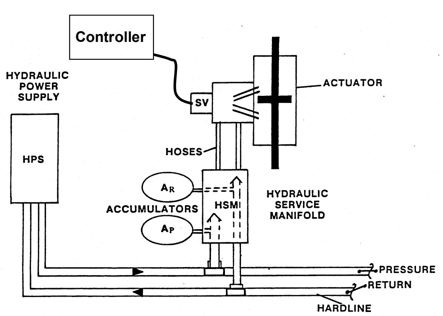
Applying the Loads...

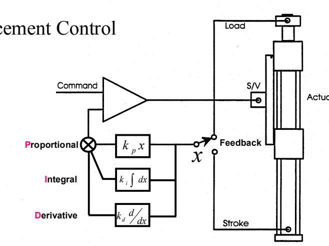
- Why Servo-hydraulic control?
  - Precise displacement, velocity, acceleration or load control
  - Displacement, force and frequency range match general automotive structural test applications well (up to ~1m, up to ~250kN, up to ~100Hz)
  - Flexible in operation. Capable of reproducing any kind of command input
- Lower frequency/simpler fixed cyclic loading applications
  - Electric motor driven scotch yoke, cam..
- Higher frequency/lower load
  - Electro-dynamic shakers

Servo Hydraulic System



Servo Loop, PID Control

Load Control
vs.
Displacement Control



Servo Loop Performance

- Overall performance of the system exists <u>within</u> the performance envelope of the hydraulic system
- All hydraulic servo systems require an error (command - feedback) to move
  - **P**roportional gain controls the servo error
  - **I**ntegral gain controls the "following" error
  - **D**erivative gain provides high frequency stability
- Other compensation may be required

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Compensation Methods

- Measure desired and actual response
- Modify:
  a) control parameters - "inside the loop"
  b) command signal - "outside the loop"

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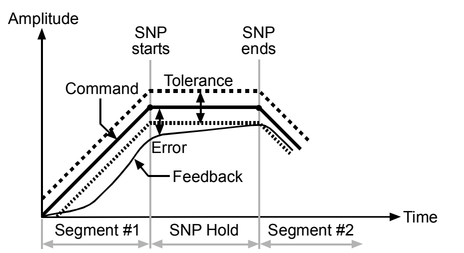
"Outside the loop"
Static Null Pacing



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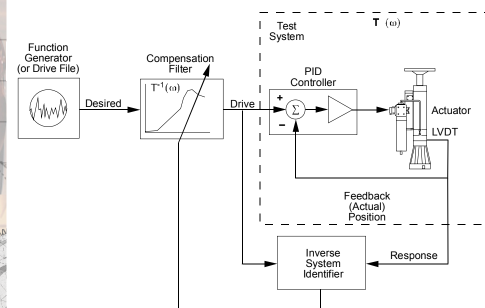
Adaptive Inverse Control



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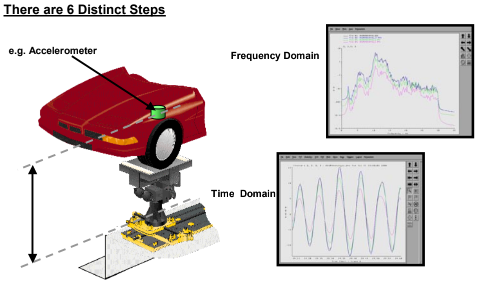
Iterative Deconvolution

Simulation technique used to repeatedly replicate and analyze "in service" vibrations and motions of a specimen using a dynamic mechanical system in a controlled laboratory environment.

<u>There are 6 Distinct Steps</u>



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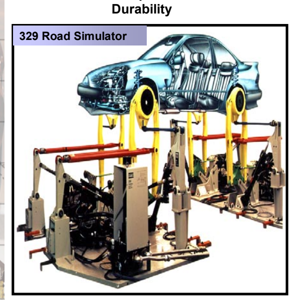
Iterative Deconvolution Uses & Applications

Evaluate Complete Structure Durability



Evaluate Component Structure Durability or Performance Characteristics

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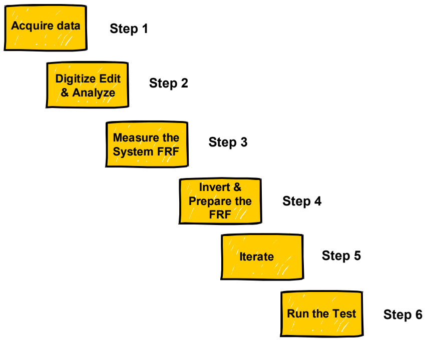
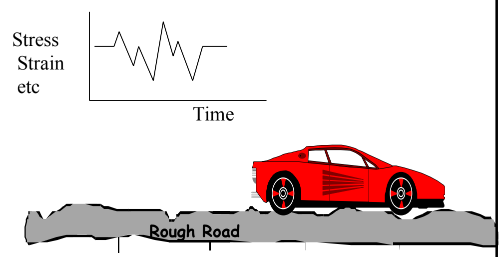
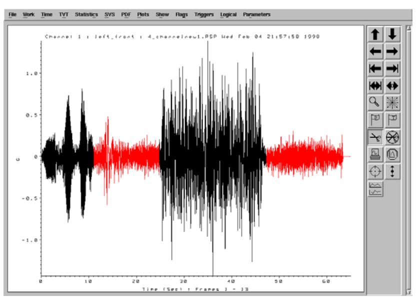
What is Iterative Deconvolution



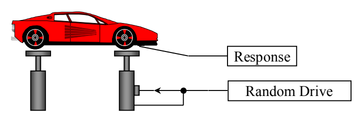
Step 1: Road data collection with an instrumented vehicle



Step 2: Analyzing & Editing of data



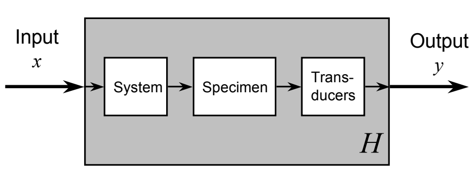
Step 3: Measure System Frequency Response Function (FRF)



$$FRF = [H] = \frac{G_{xy}(f)}{G_{xx}(f)}$$

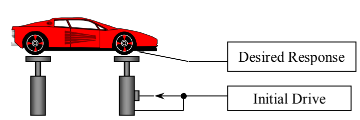
[H] = amplitude and phase relationship between actuator inputs and the specimen transducer responses

Frequency Response Function



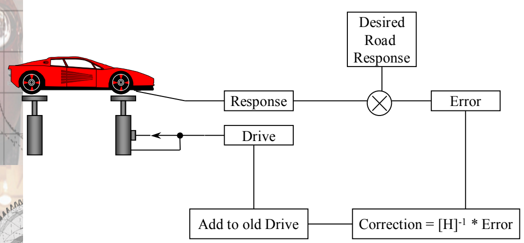
$$H = \frac{y}{x}$$

Step 4: Estimate the Initial Drive



Initial Drive = $[H]^{-1}$ * Desired Response * Gain Factor

Step 5: The RPC Iteration Process



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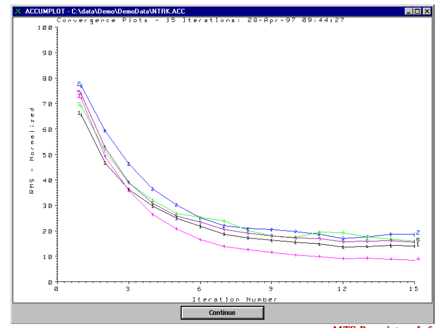
Convergence Analysis



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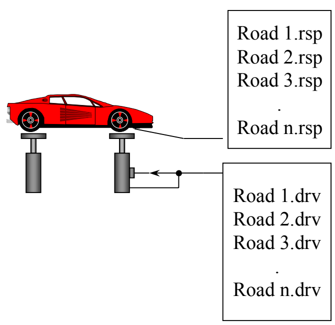
Step 6: Durability Testing...



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