Master's Dissertation at the Div. of Structural Mechanics

MODELLING NON-LINEAR DYNAMICS OF RUBBER BUSHINGS - Parameter Identification and Validation

Anders Persson and Fredrik Karlsson

Presentation
Spring of 2003

Report
will be published as report TVSM-5119

Supervisors
Per-Erik Austrell, *Ph.D.*
Div. of Structural Mechanics

Jan Hellberg, *M.Sc.*
Vehicle Dynamics, Volvo Car Corp.

Anders Wirje, *M.Sc.*
Strength and Durability Center, Volvo Car Corp.

The work is performed at
Div. of Structural Mechanics, Lund Institute of Technology, Lund University

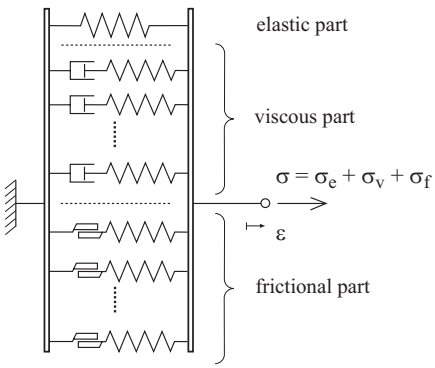
In cooperation with
Volvo Car Corporation and Forsheda

LUND UNIVERSITY

Background
Rubber bushings can be found in all vehicle suspension systems. The suspension components are connected to each other, to the subframe, and to the body structure via rubber bushings. They are a key element in designing desired quasi-static and dynamic behaviour of suspension systems. The dynamic characteristics of a rubber bushing are often very complex in nature, due to the fact that the response is dependent on several variables, such as displacement, frequency, amplitude, preload, and temperature. The displacement dependence is predominant, but the other dependencies can be absolutely critical in capturing the mechanical behaviour.

Assignment
The ultimate objective is to establish a methodology for rubber bushing modelling and parameter identification.

Major activities
- *Create and study different 1-D bushing models in MATLAB:*
  - *Visco-elastic models including the Kelvin-Voigt model (no amplitude dependence).*
  - *Elasto-plastic models (no frequency dependence).*
  - *Generalized visco-plastic (viscoelastic-elastoplastic) models (both frequency and amplitude dependence).*



Generalized visco-plastic material model

- *Develop a methodology for model parameter identification from physical component tests.*
- *Validate the bushing models by comparison with component testing.*

Validation
Three rubber components will be used to validate the bushing models for quasi-static and harmonic dynamic behaviour. Two of the components are geometrically simple model components and the third is an actual component used in a Volvo car.