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### Outline

- Aim with the Car.mo library
- From the top to the bottom!
- Library contents
- Examples
- Related libraries
- Future improvments



#### Aim with the Car.mo library

- Driving Dynamics evaluation
  - Critical maneouvres
  - Lateral performance
  - Longitudinal performance
  - Comfort
  - Etc.



# From the top to the bottom!

### Focus on chassis



#### A car model





#### **Chassis interface**





#### **Chassis model**



#### **Suspension Interface**



#### Suspension model (MacPherson)



#### Suspension model (MultiLink4)





#### Linkage model (MacPherson)





#### **Component model (MacPherson strut)**









#### Vehicle model





# Vehicle model Chassis model





# Vehicle model Chassis model Suspension model





Vehicle model Chassis model Suspension model Linkage model





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Vehicle model
Chassis model
Suspension model
Linkage model
Component model



# Library contents



#### Library contents





# Usage



#### Usage – Exsisting examples





#### Usage – Own models





#### Usage – With other libraries





#### Usage – Visualised performance





### **Usage - Suspension mapping**







## Usage - Comfort issues





### **Related libraries**



#### PlanarMultiBody.mo





#### Forces.mo



























- Chassis modelling
- Driving dynamics simulation
- Interfacing other Modelica libraries



## **Future Improvements**



### **Evaluation aids**

- Related models
  - Drivers
  - Automatic test rigs
- Motion constraints
  - Constant speed maneouvres
  - Constant radius turns

## **Extended flexibility**

- With/without bushings
- Linear/nonlinear spring-dampers
- Swapping tyre models
- 1D-2D-3D geometries and combinations

### **Extended flexibility**

Different models share same interface.
 – Model focus/viewpoint can be changed easilly!



#### Different models share same interface



#### Different models share same interface



Drivina

*namics* 

### **Extended flexibility**

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  - Model focus/viewpoint can be changed easilly!
  - Higher requirements on interfaces!



#### Suitable interfaces?





### **Extended flexibility**

- Different models share same interface.
  - Model focus/viewpoint can be changed easilly!
  - Higher requirements on interfaces!
  - Over-all model structure that is suitable!



#### Suitable structure



Vehicle dynamics control systems?

Energy management?



### **Extended flexibility**

- Different models share same interface.
  - Model focus/viewpoint can be changed easilly!
  - Higher requirements on interfaces!
  - Over-all model structure that is suitable!
  - Sub-models must know their limitations!



#### **Model limitiations!**





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