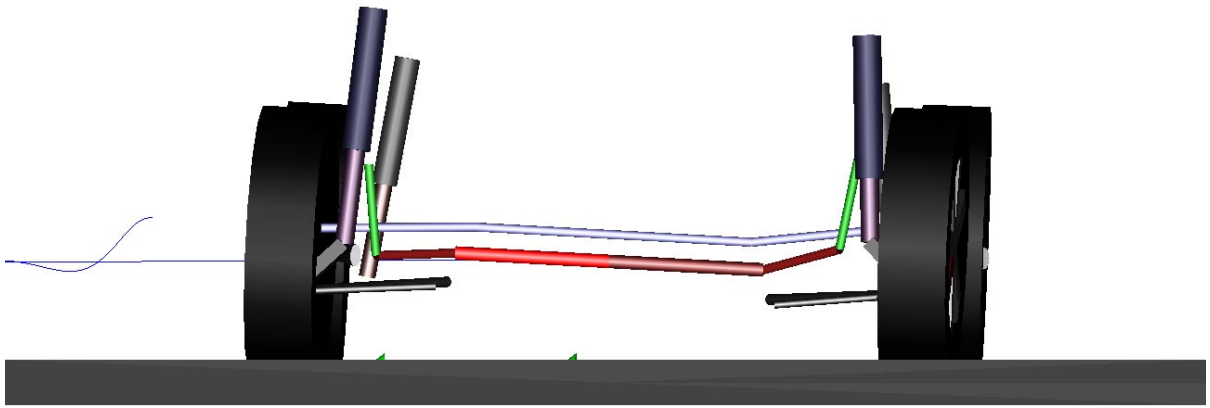
Driving Dynamics Modelling with Modelica



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Outline

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

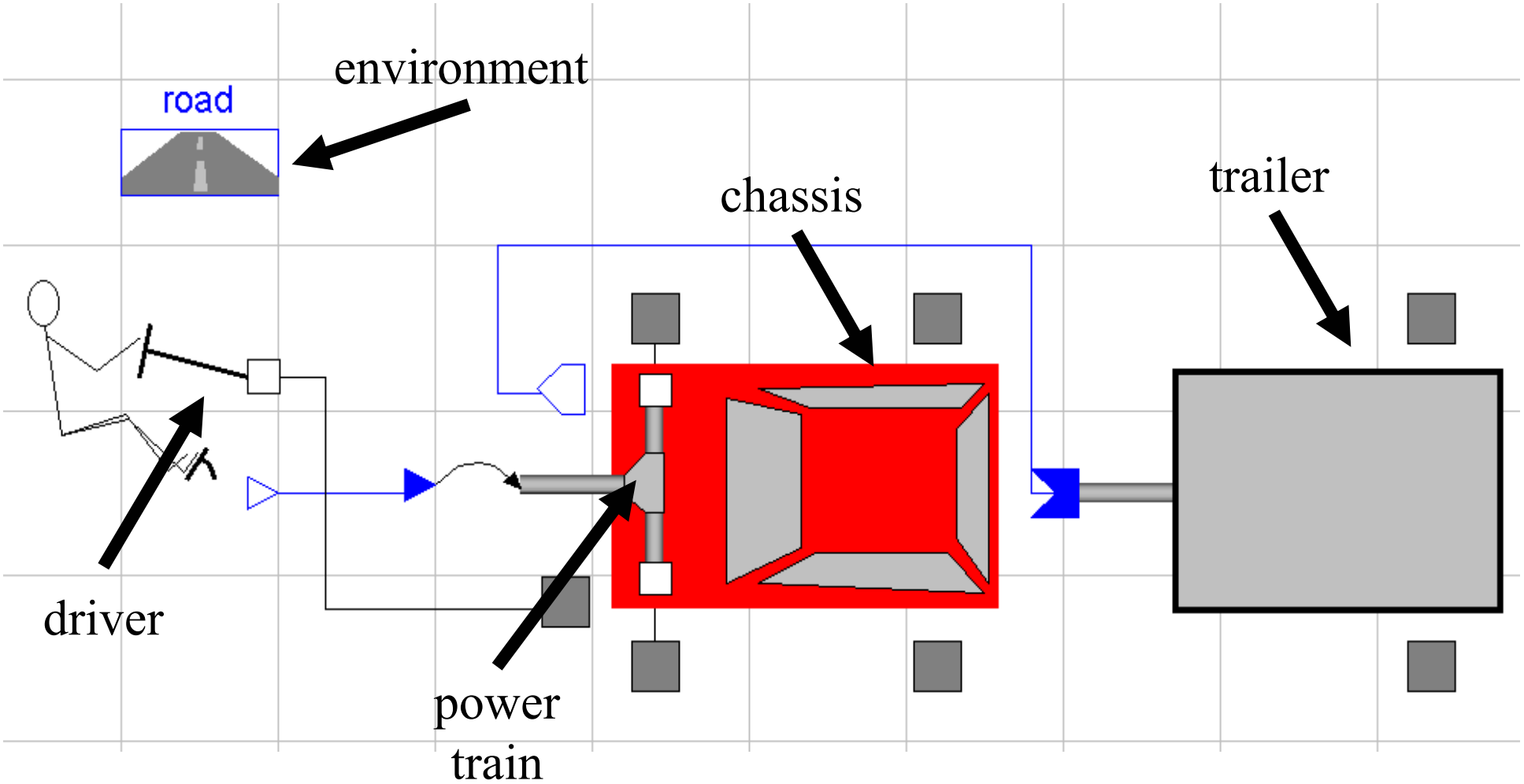
Aim with the Car.mo library

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

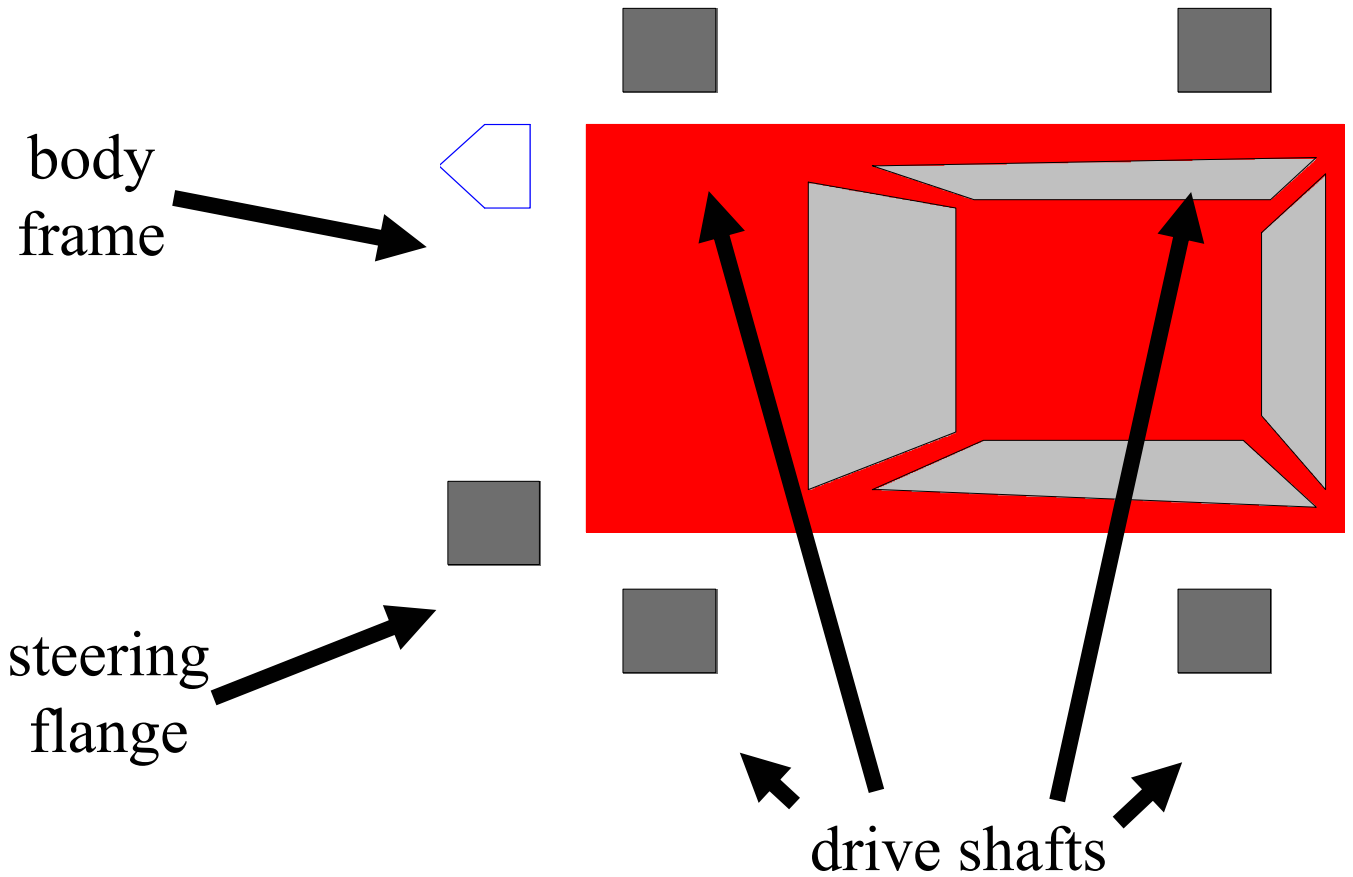
From the top to the bottom!

Focus on chassis

A car model

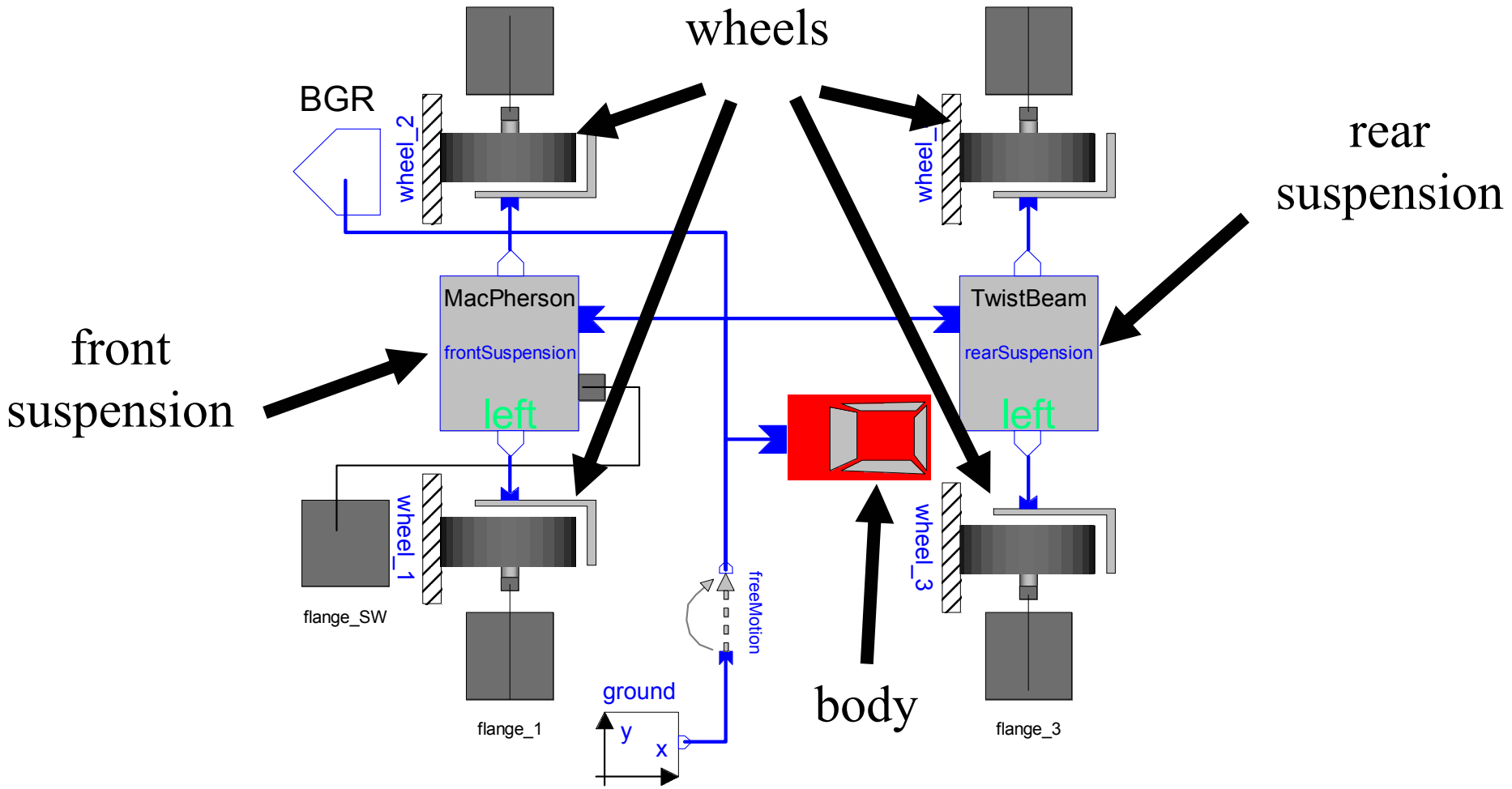


Chassis interface

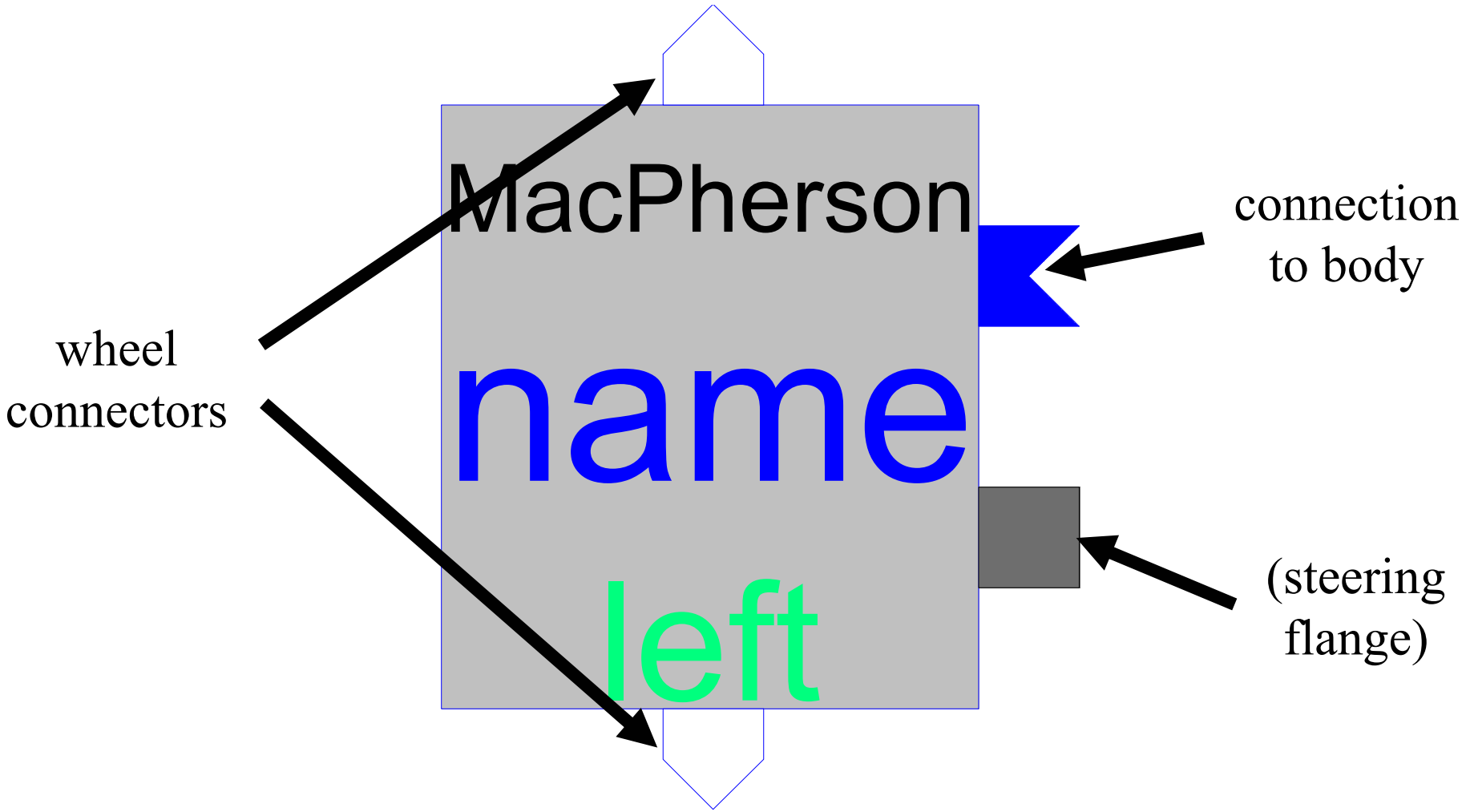


Tyre-road
interaction
as a field

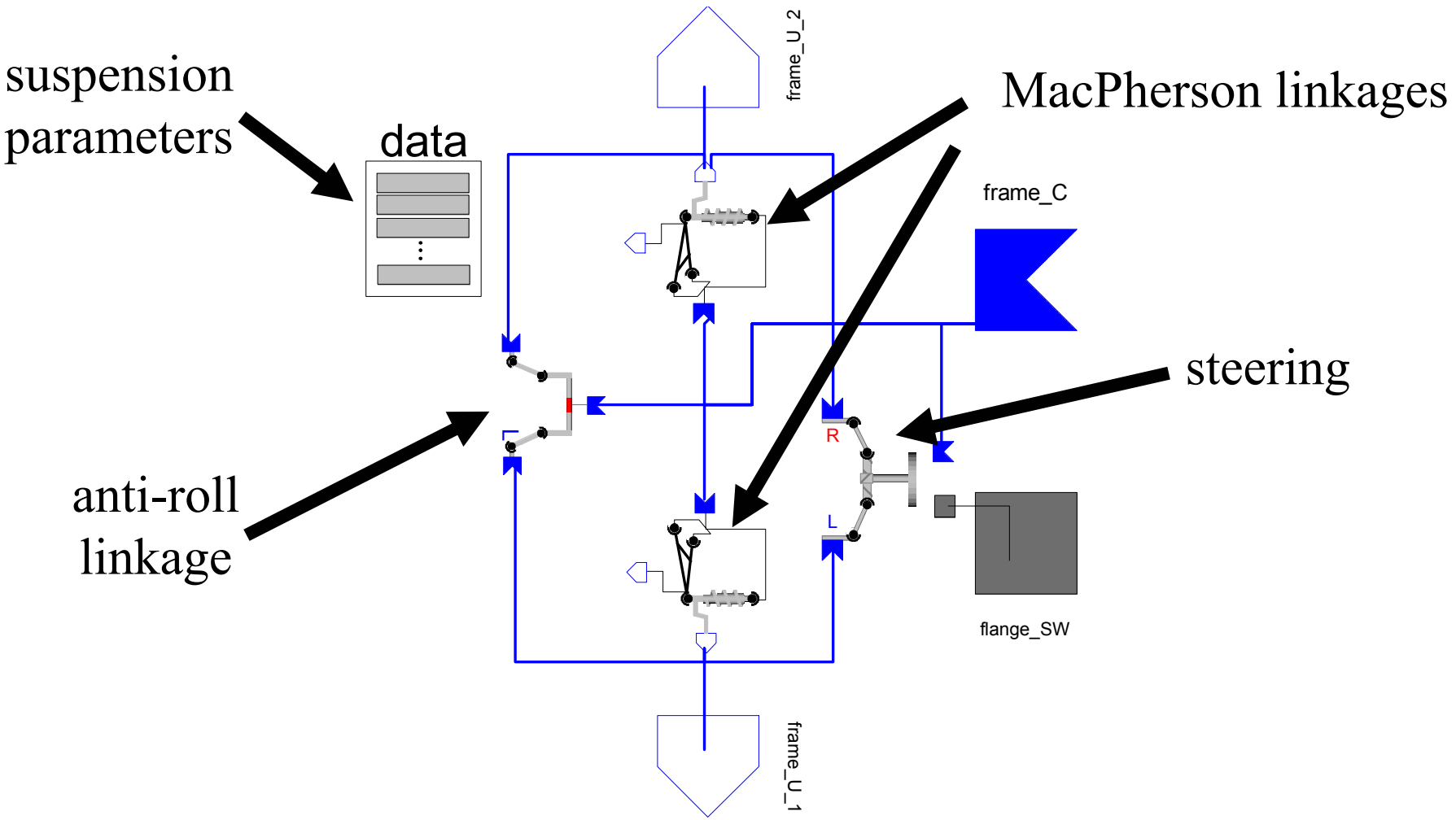
Chassis model



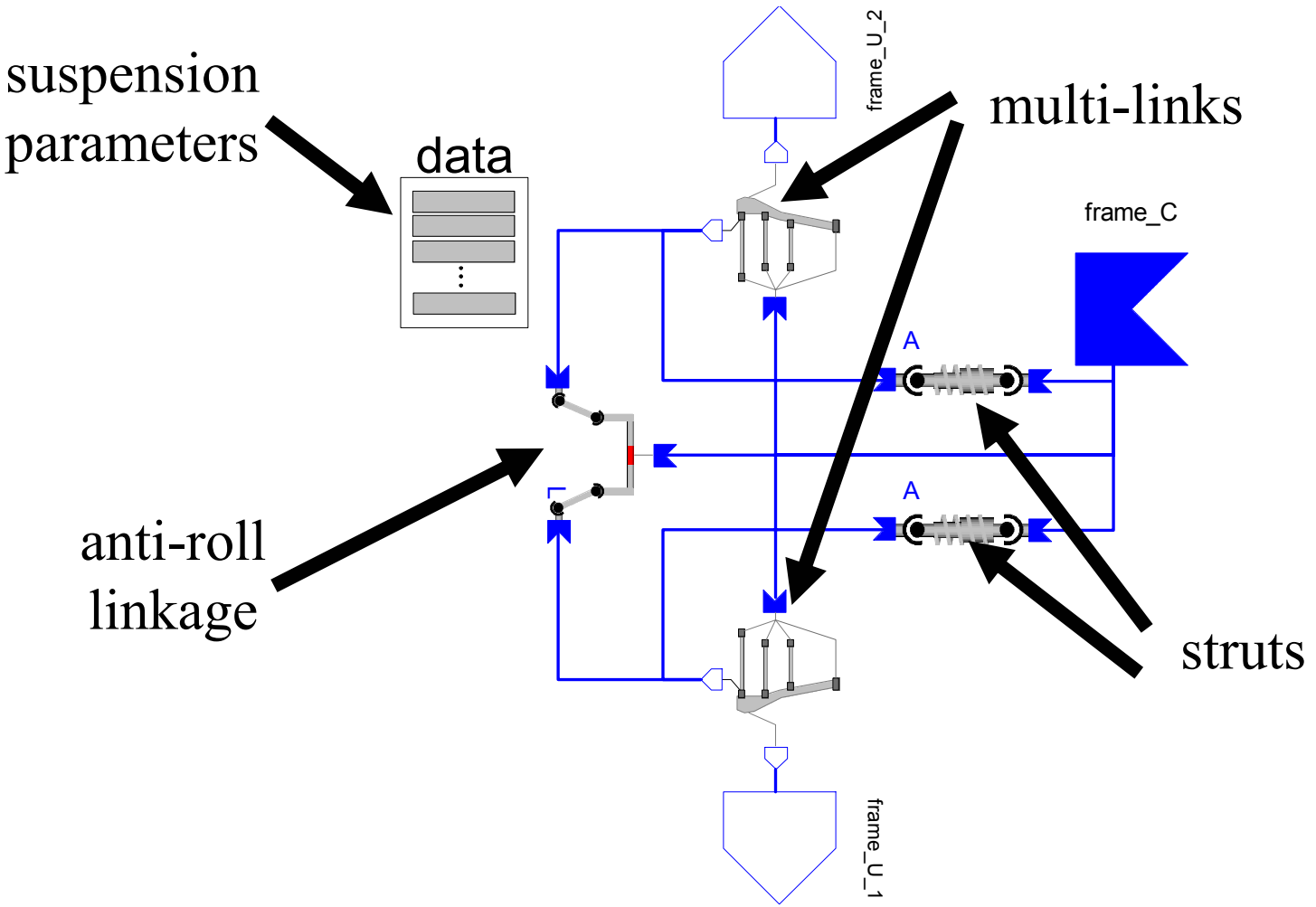
Suspension Interface



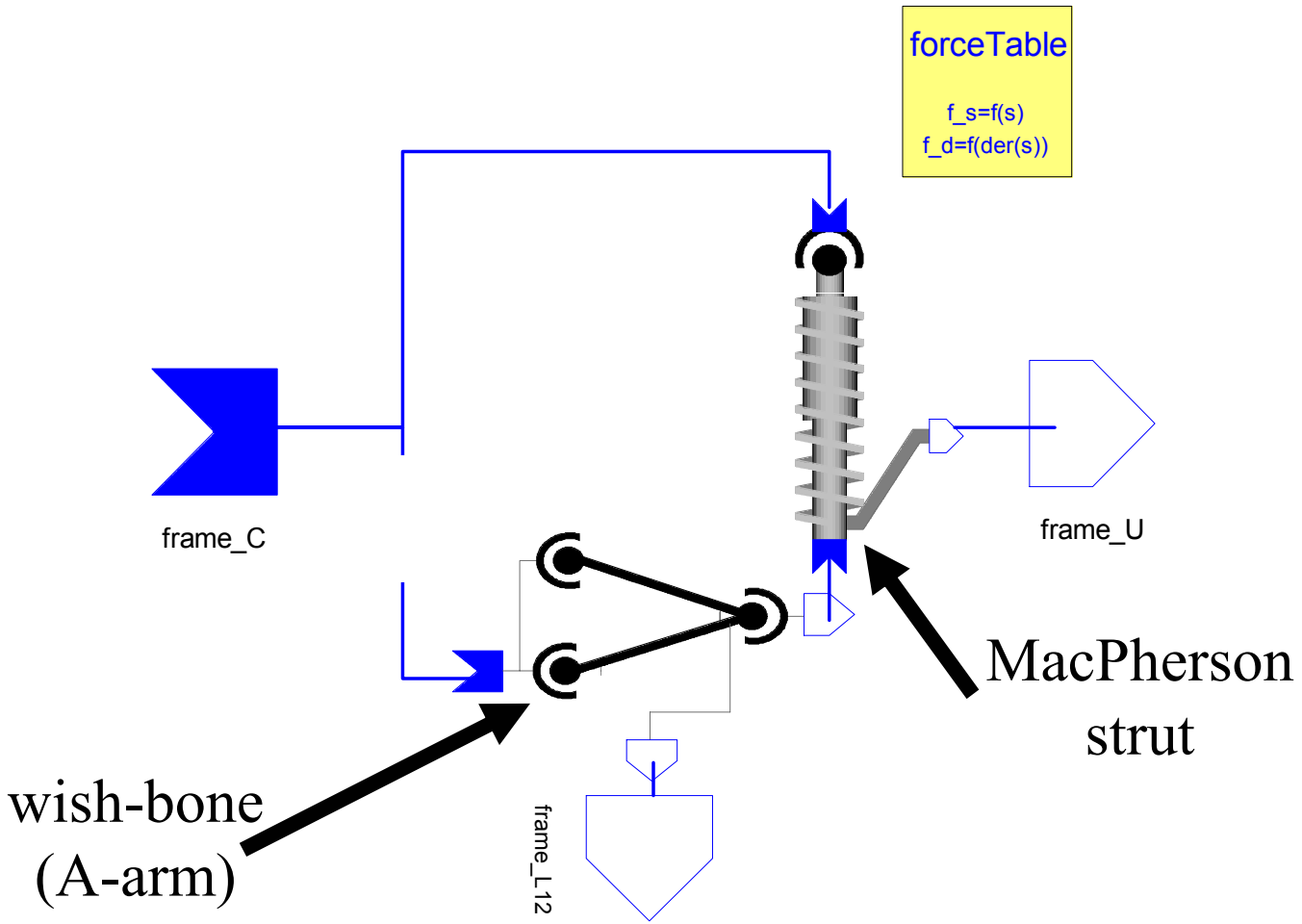
Suspension model (MacPherson)



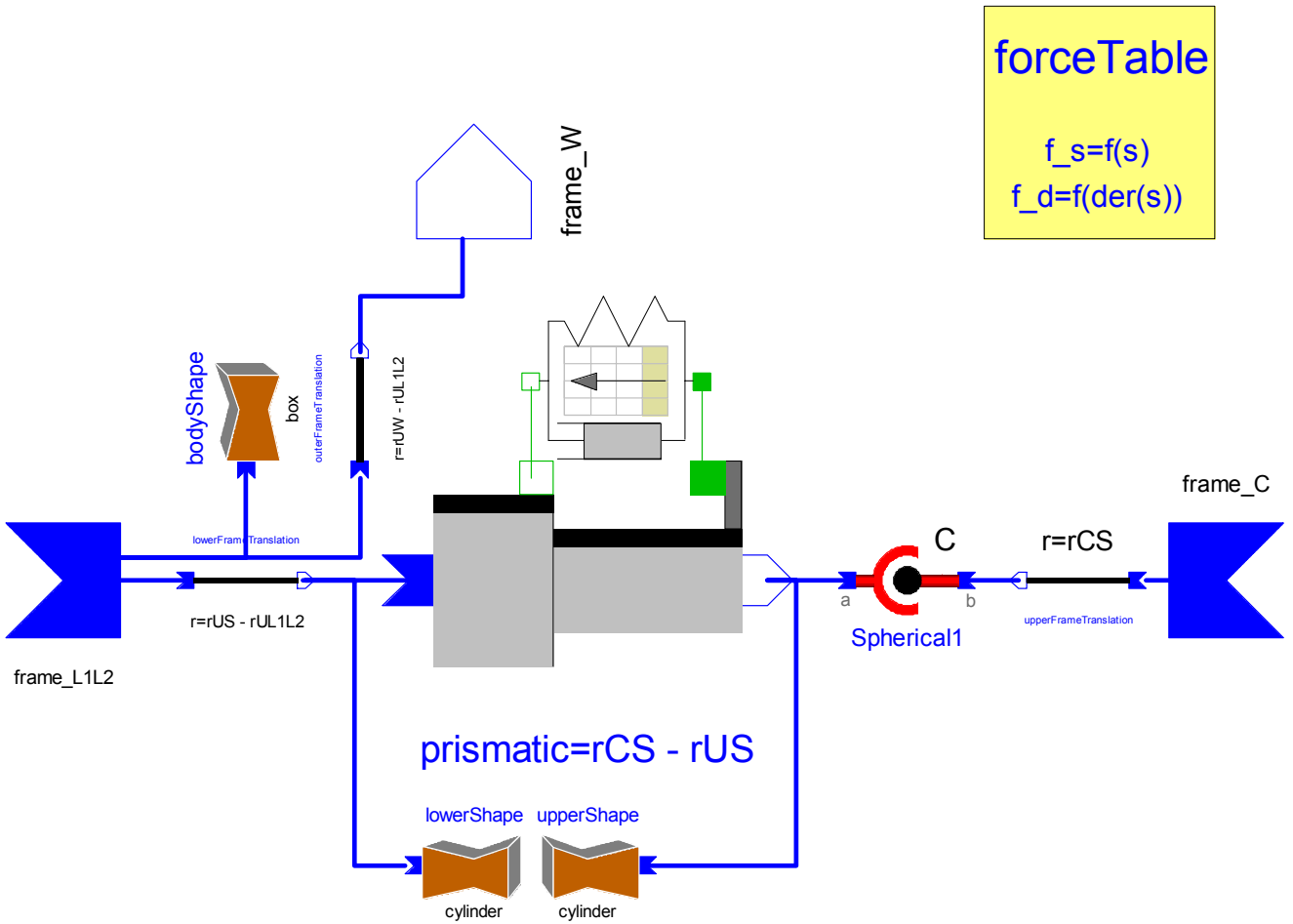
Suspension model (MultiLink4)



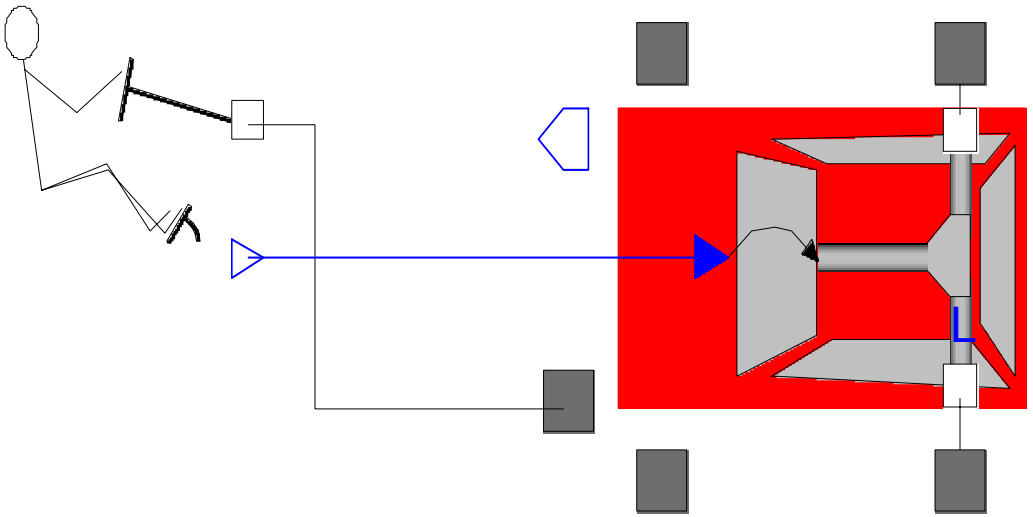
Linkage model (MacPherson)



Component model (MacPherson strut)

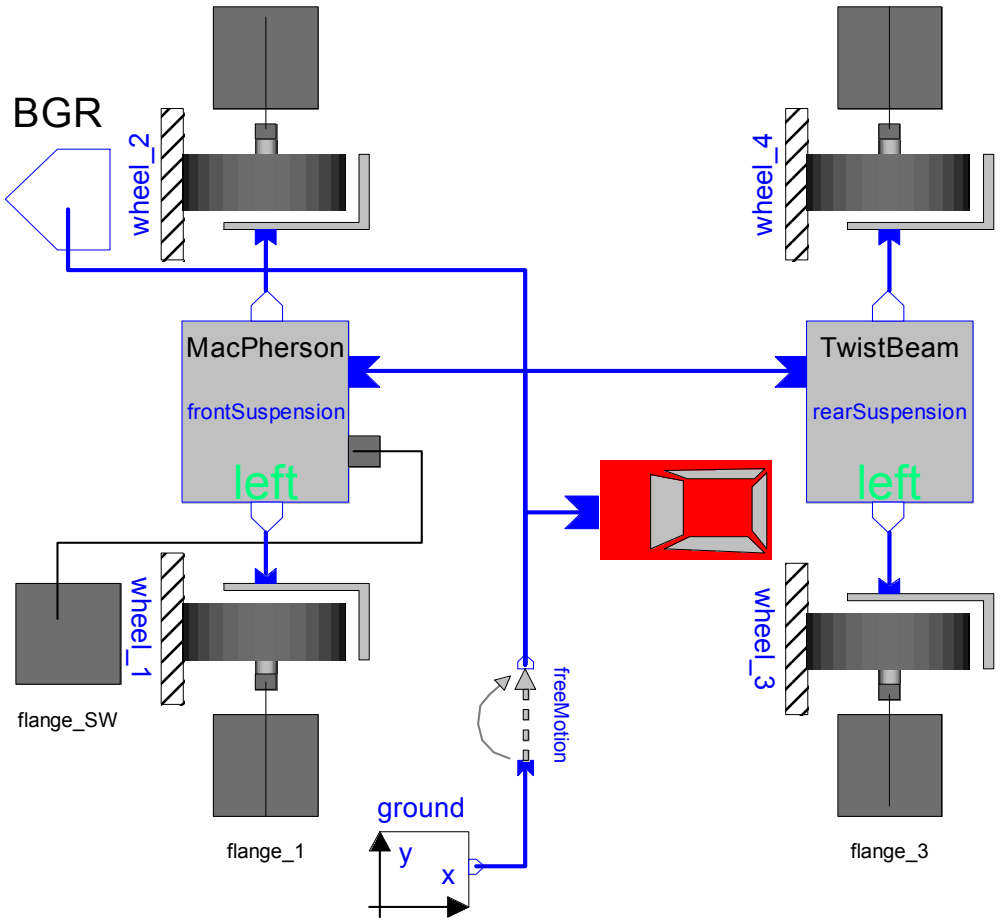


Hierarchy



Vehicle model

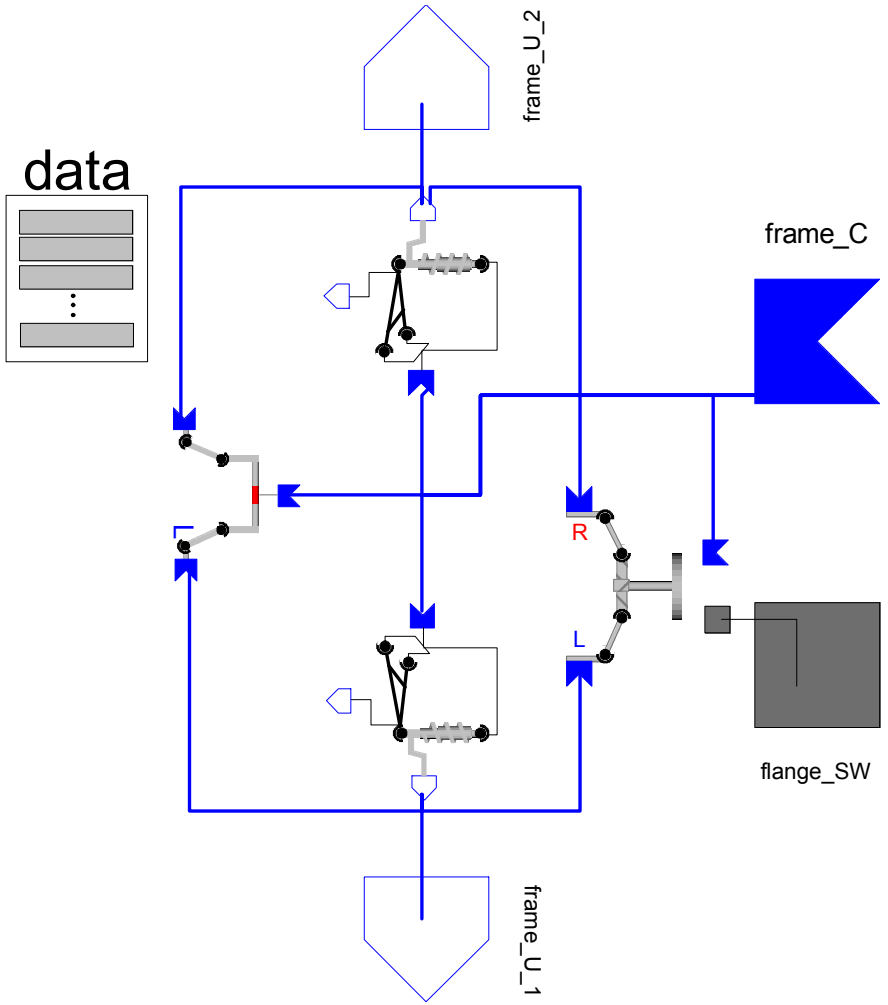
Hierarchy



Vehicle model

Chassis model

Hierarchy

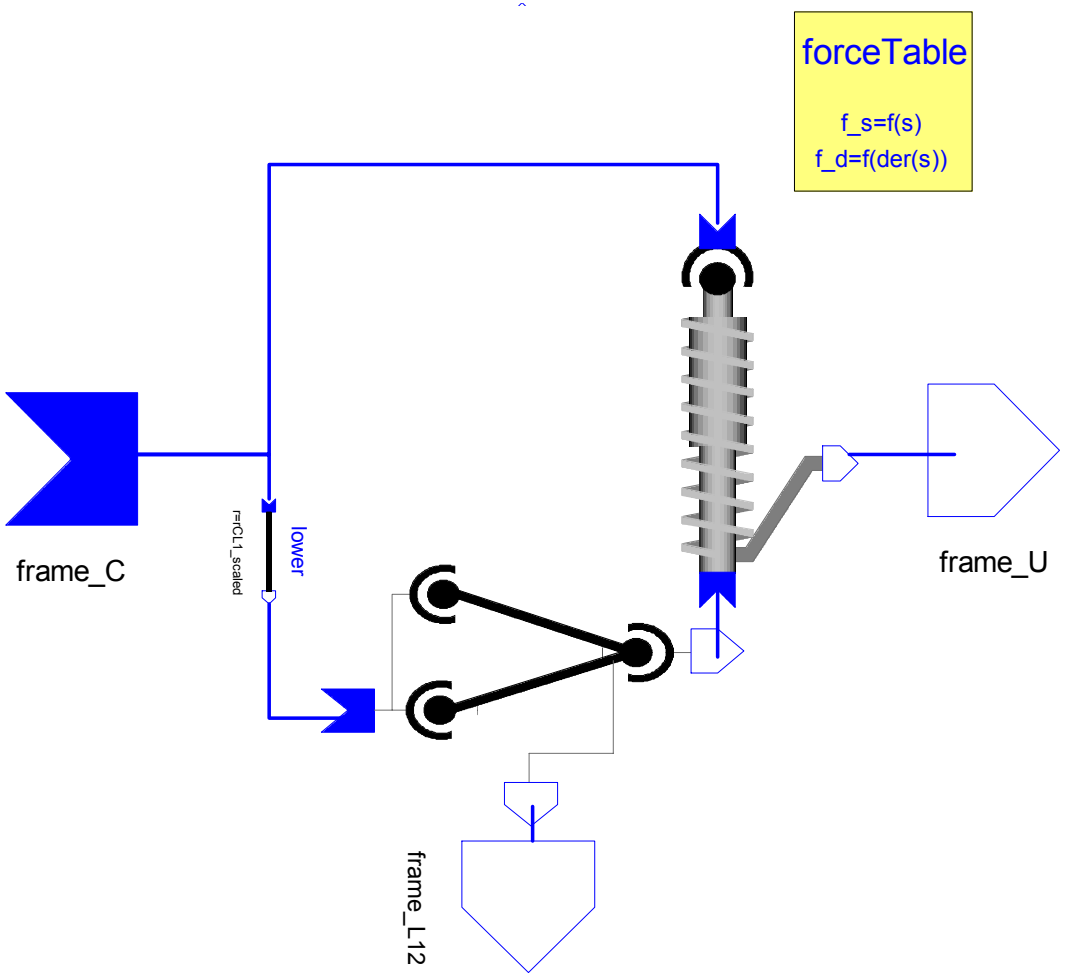


Vehicle model

Chassis model

Suspension model

Hierarchy



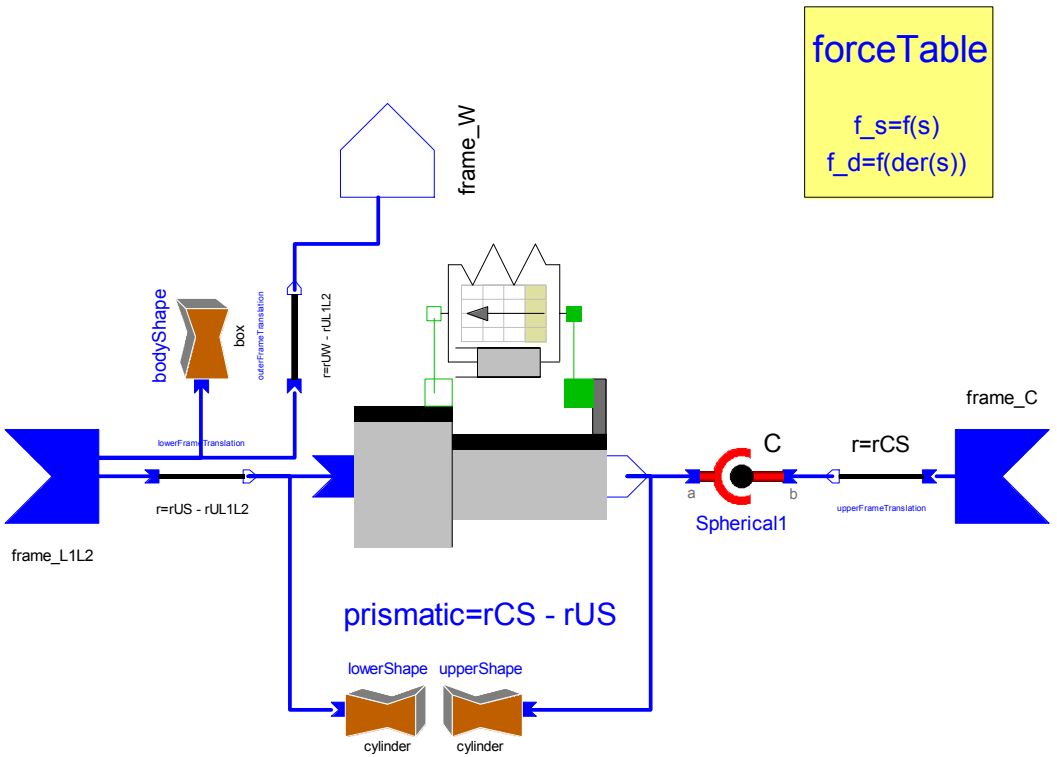
Vehicle model

Chassis model

Suspension model

Linkage model

Hierarchy



Vehicle model

Chassis model

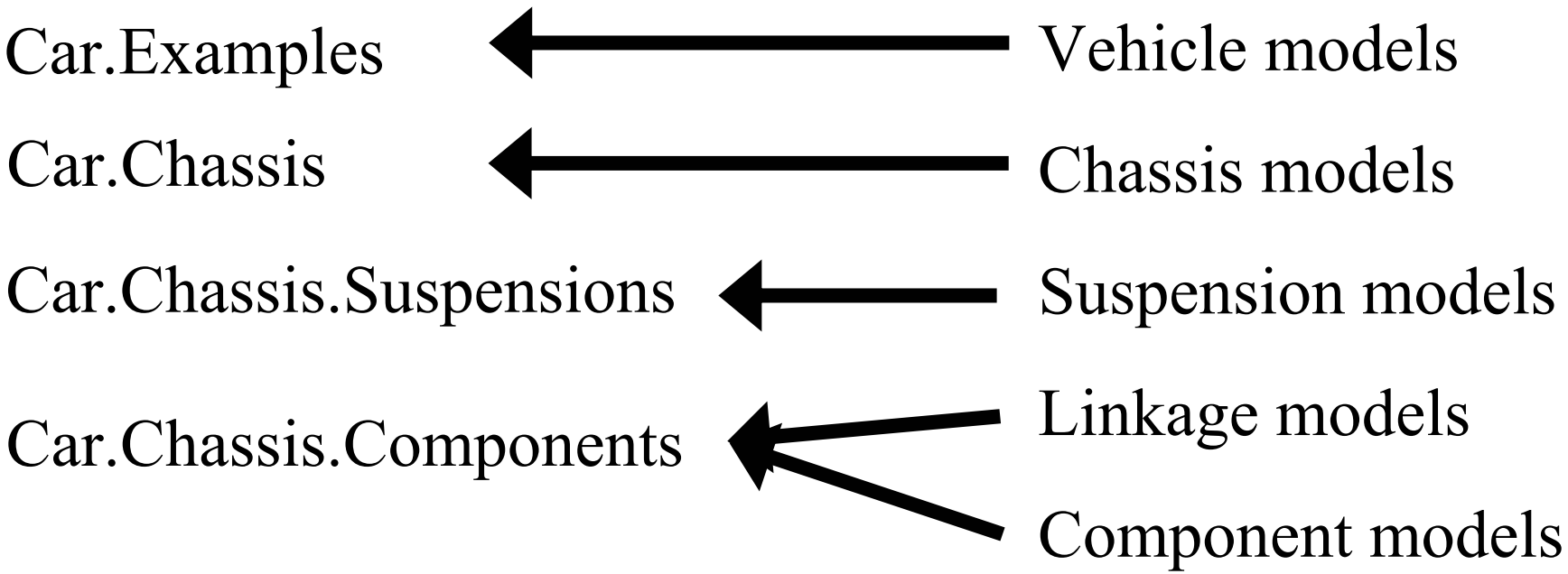
Suspension model

Linkage model

Component model

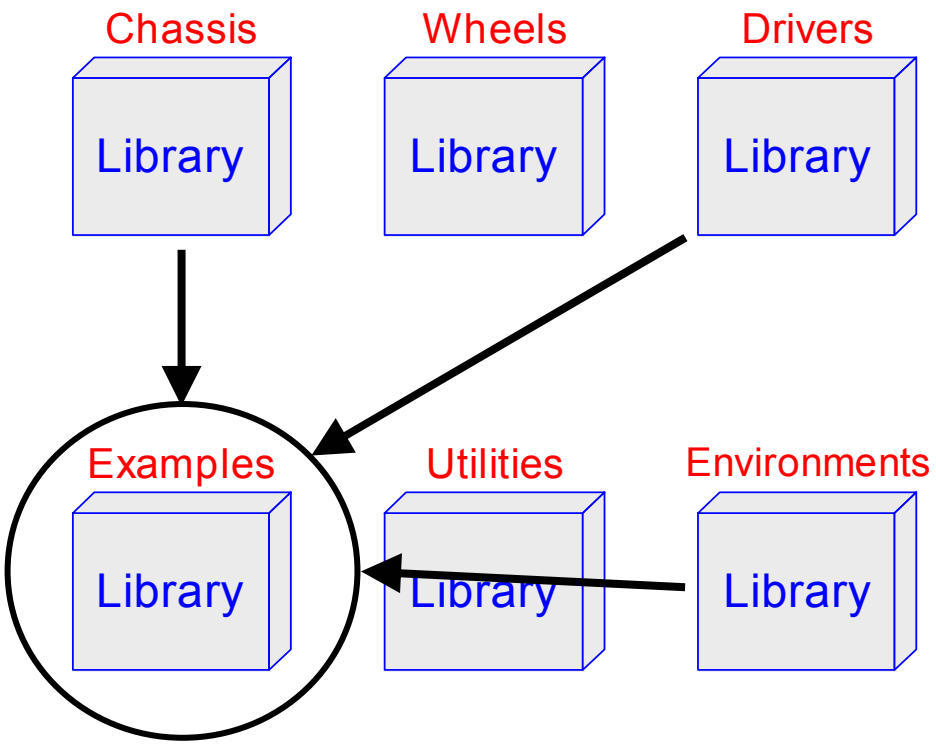
Library contents

Library contents

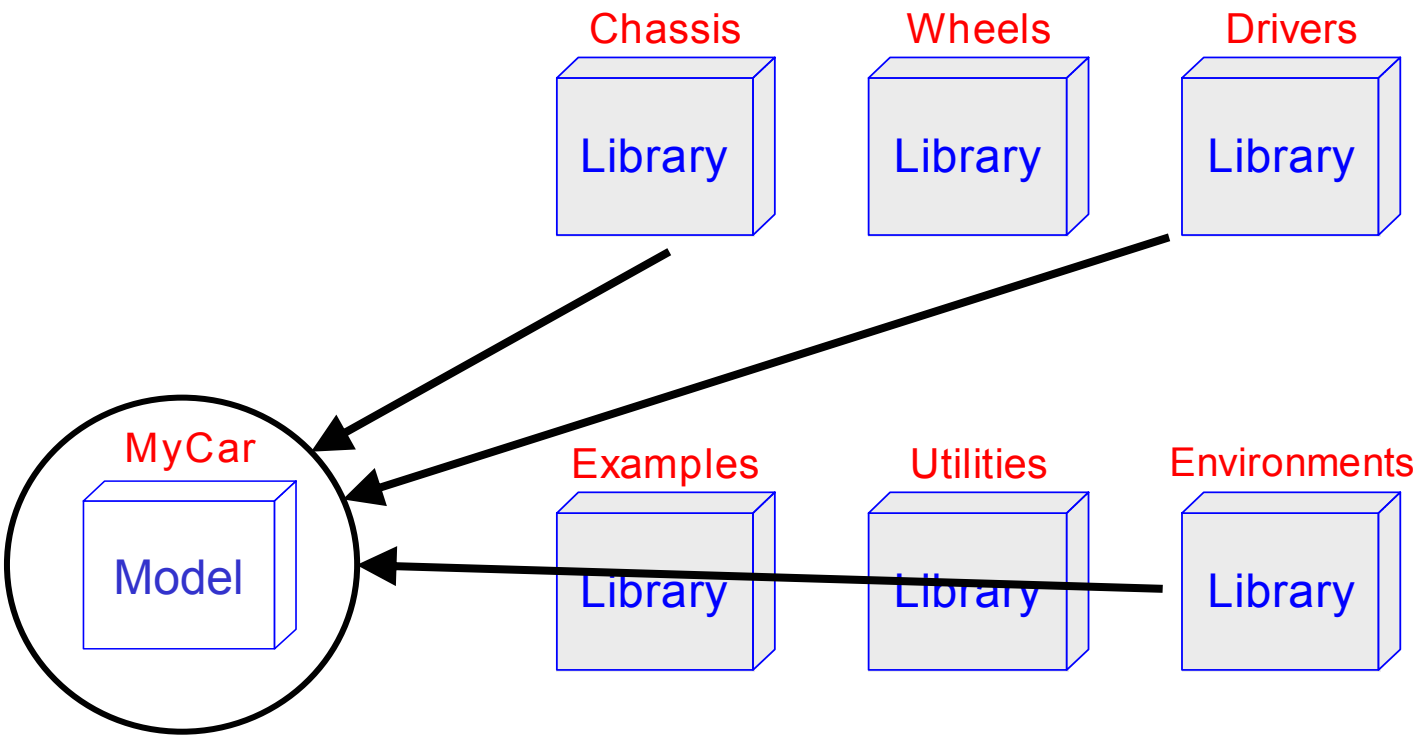


Usage

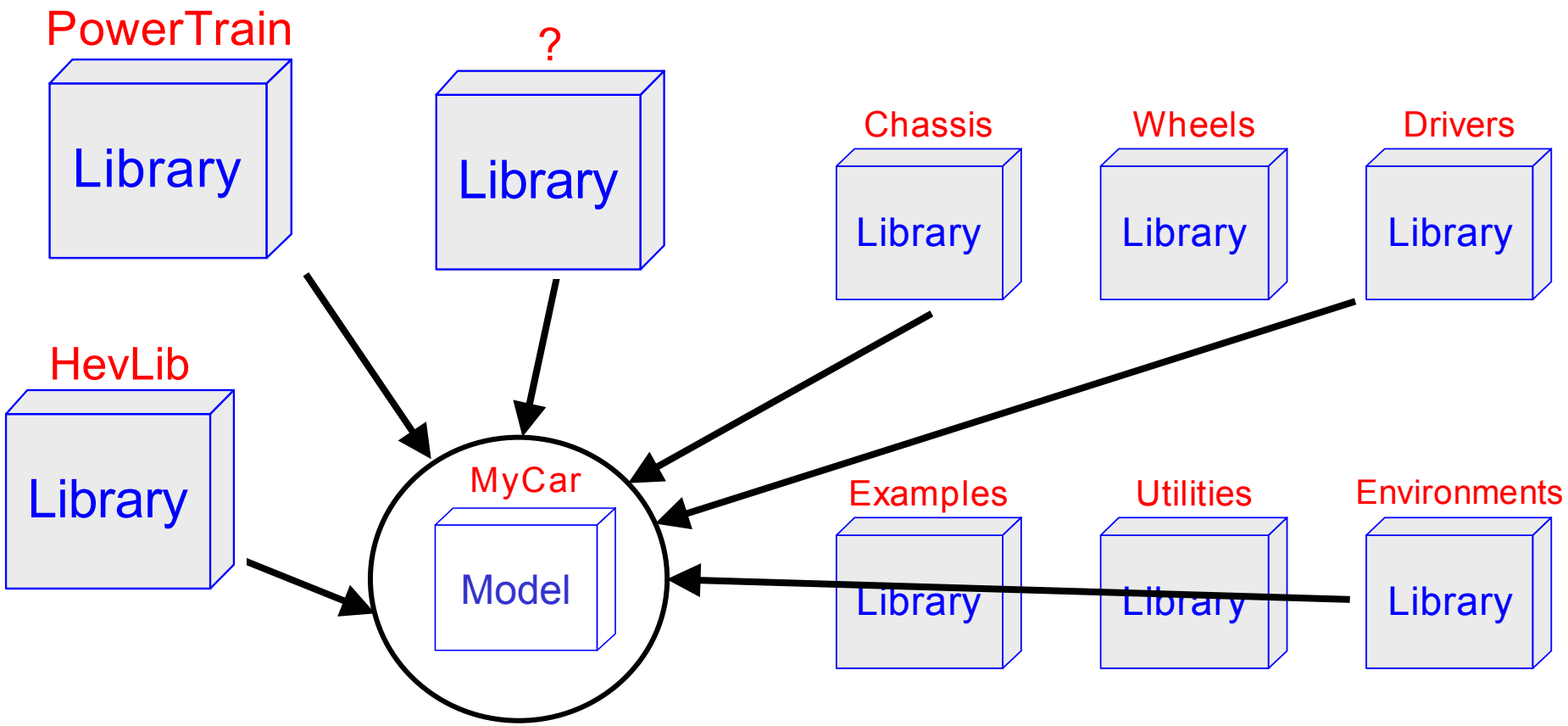
Usage – Exsisting examples



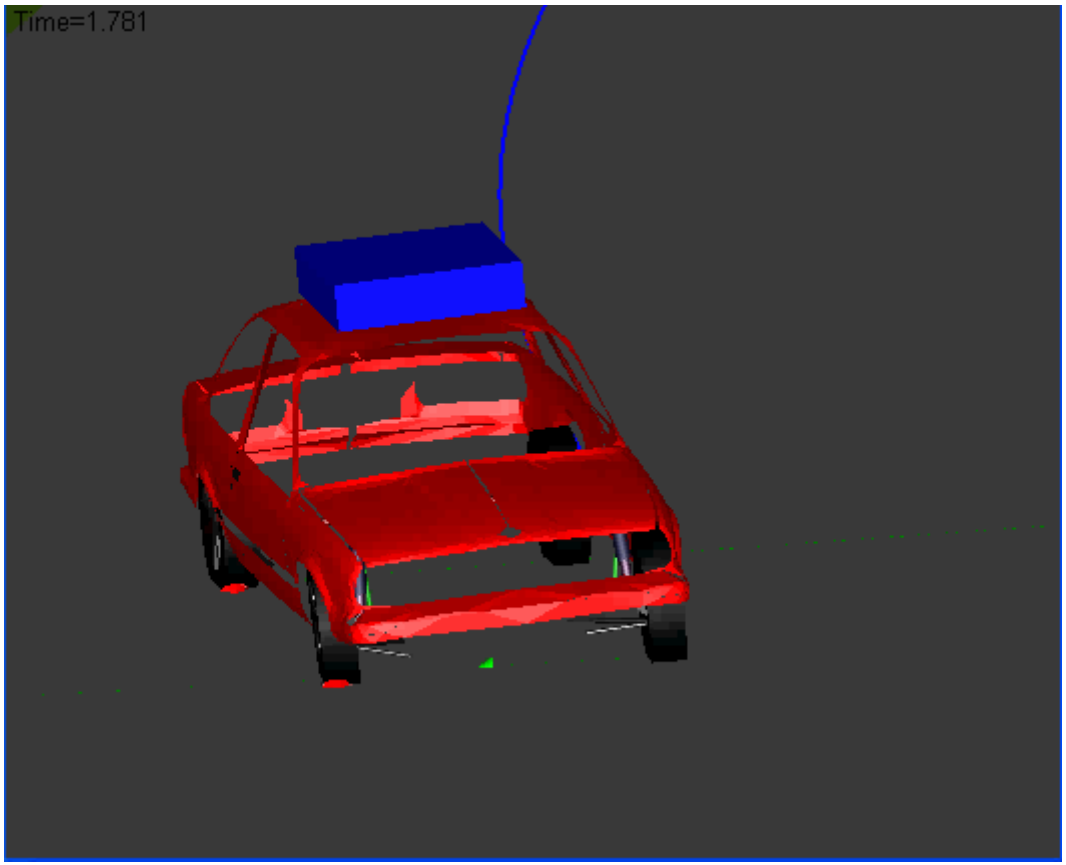
Usage – Own models



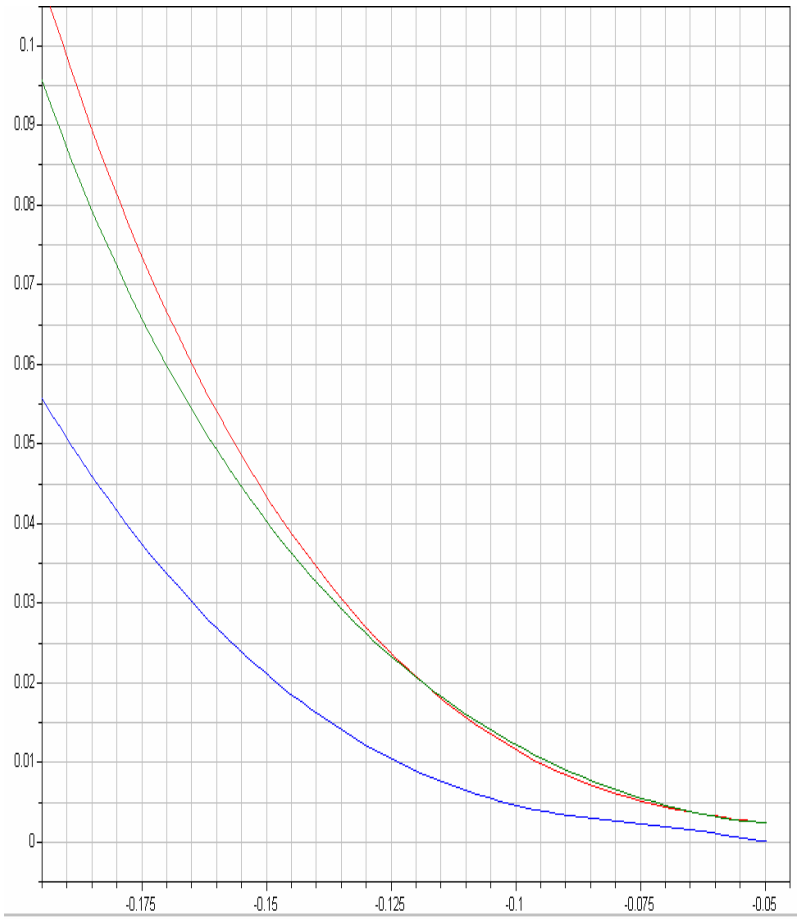
Usage – With other libraries



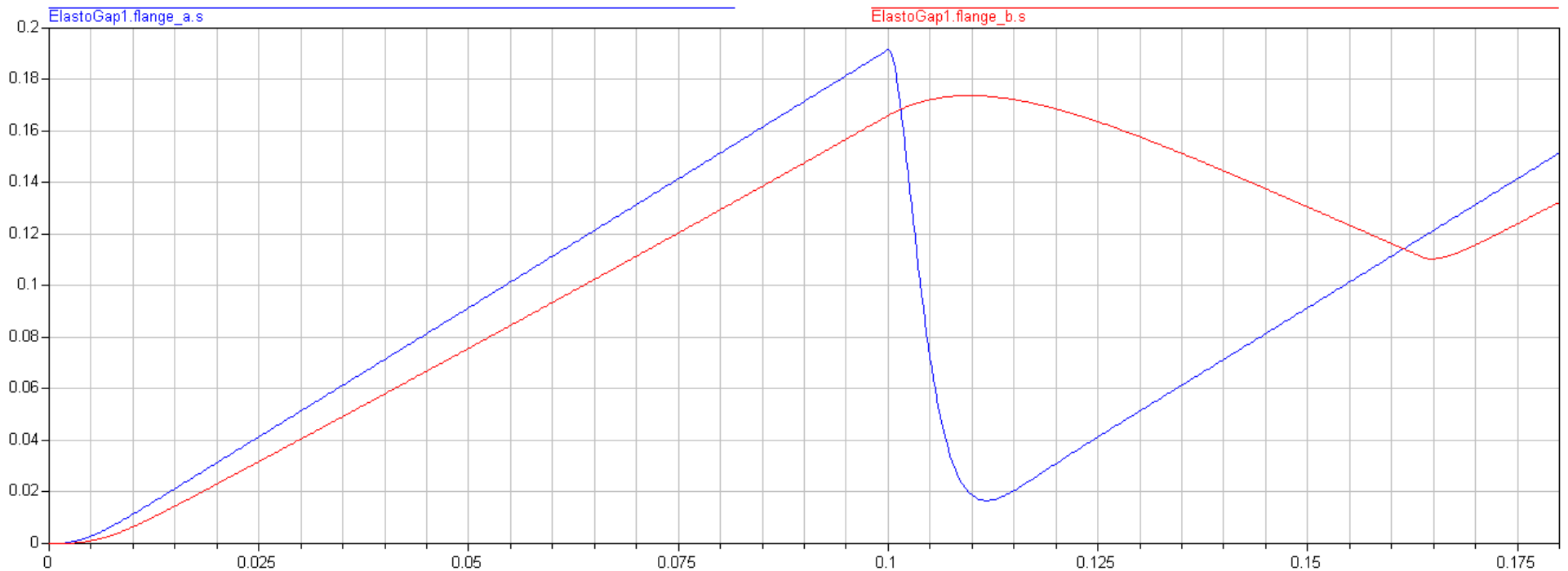
Usage – Visualised performance



Usage - Suspension mapping

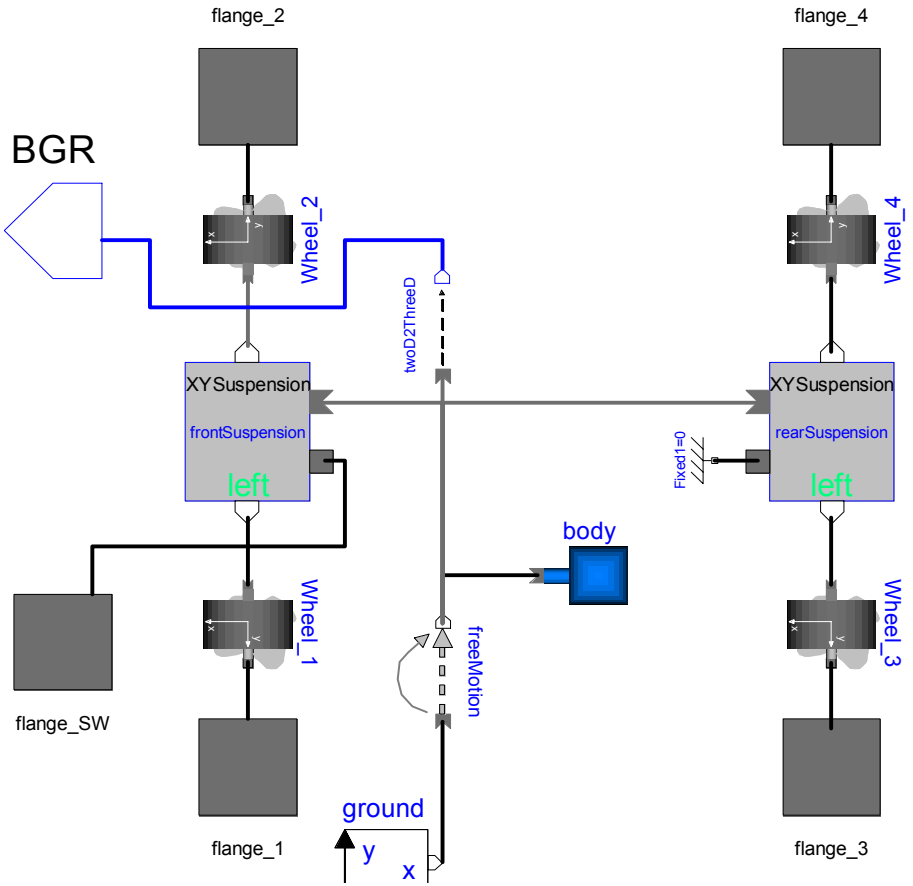


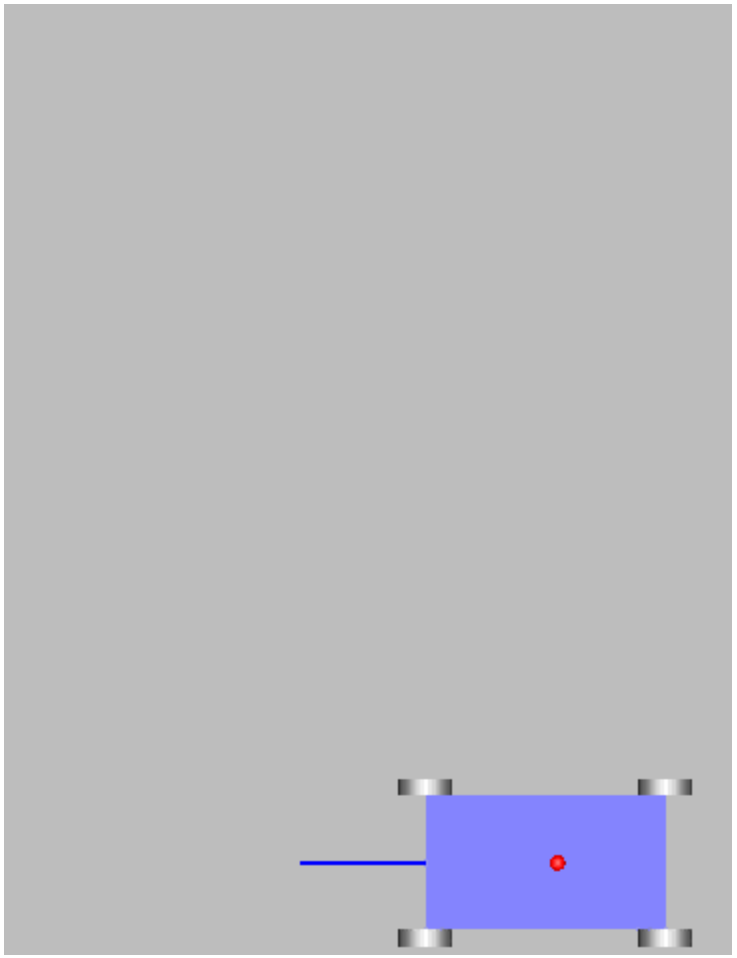
Usage - Comfort issues



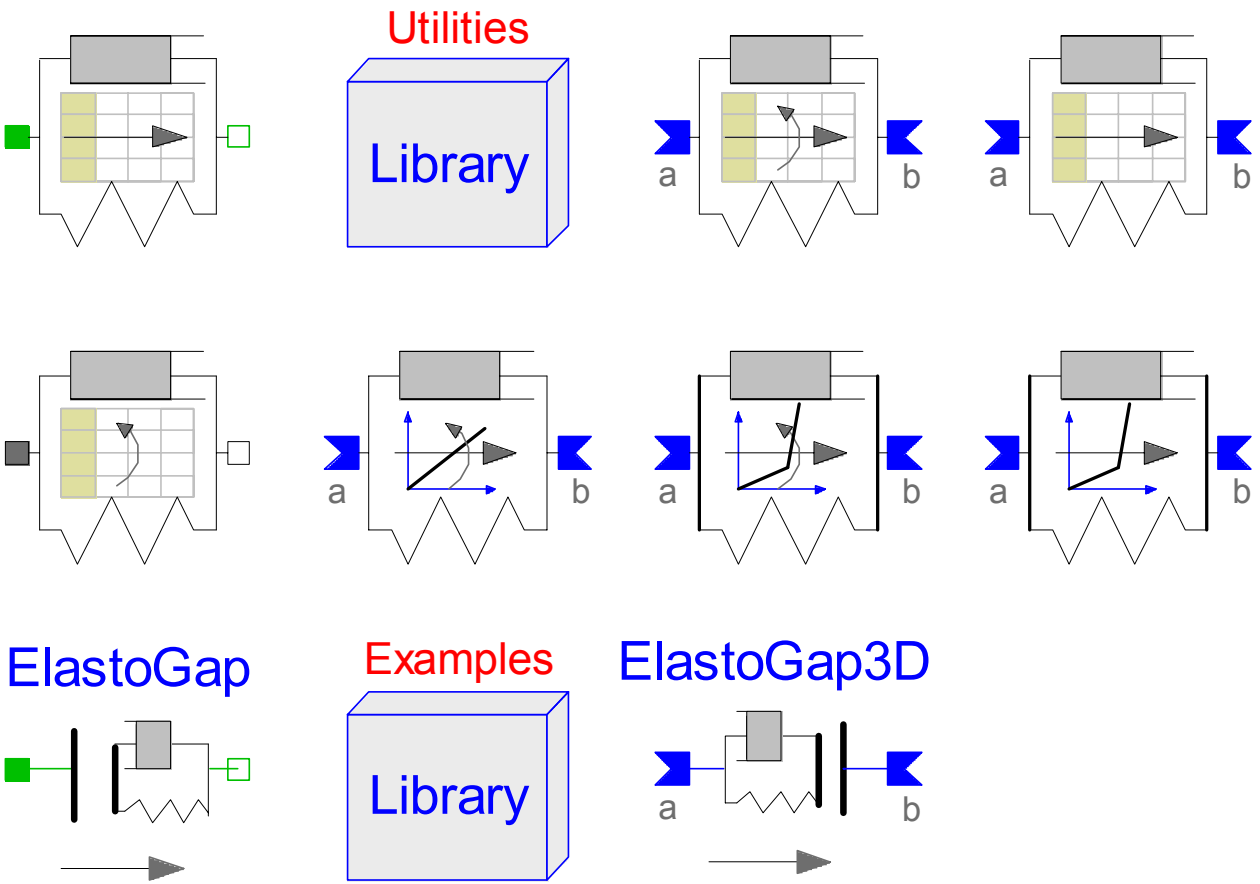
Related libraries

PlanarMultiBody.mo





Forces.mo


Utilities
Library
a
b
a
b
a
b
a
b
a
b
ElastoGap
Examples
Library
ElastoGap3D
a
b

Summary

- 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
  - ...

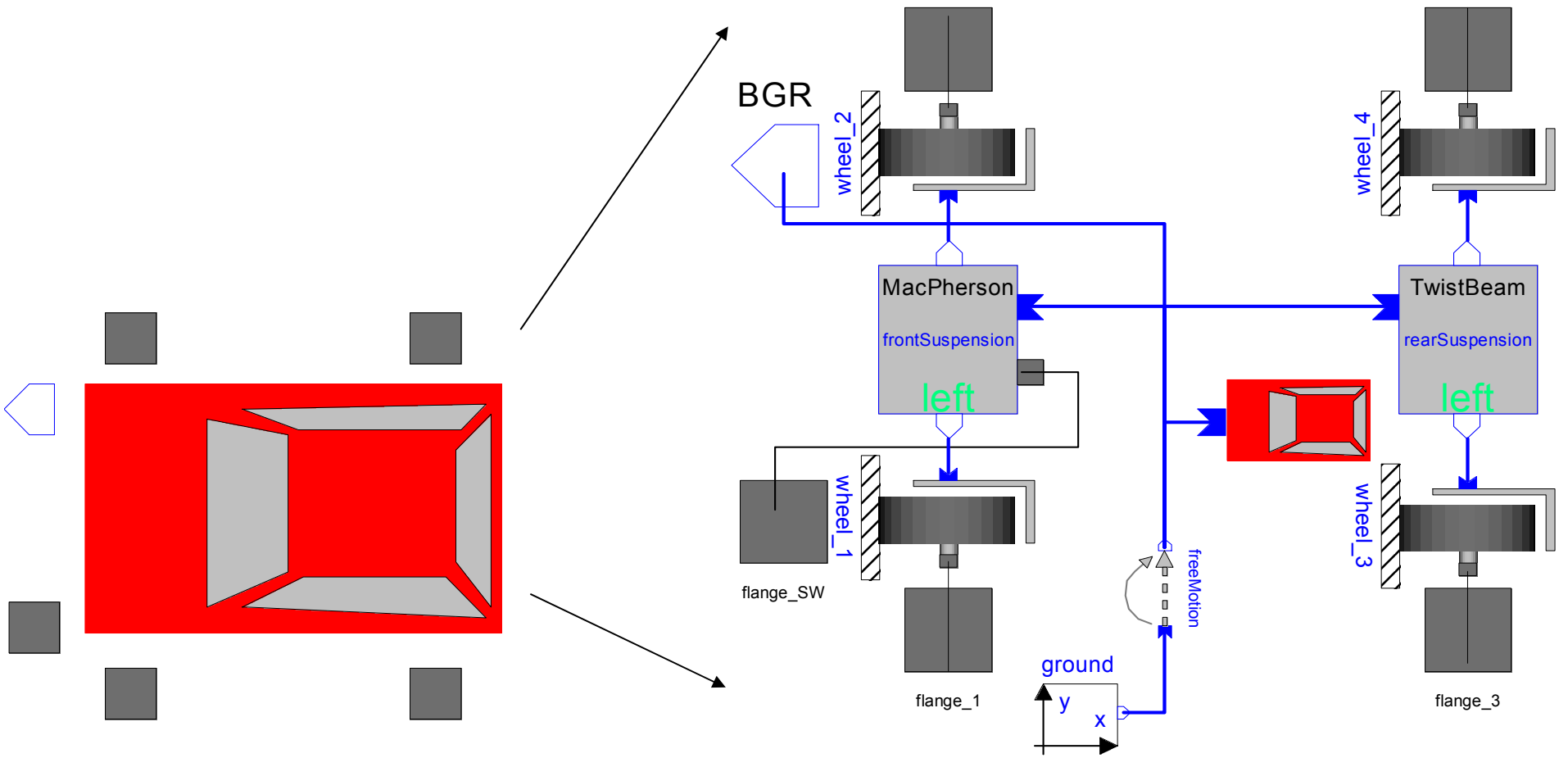
Extended flexibility

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

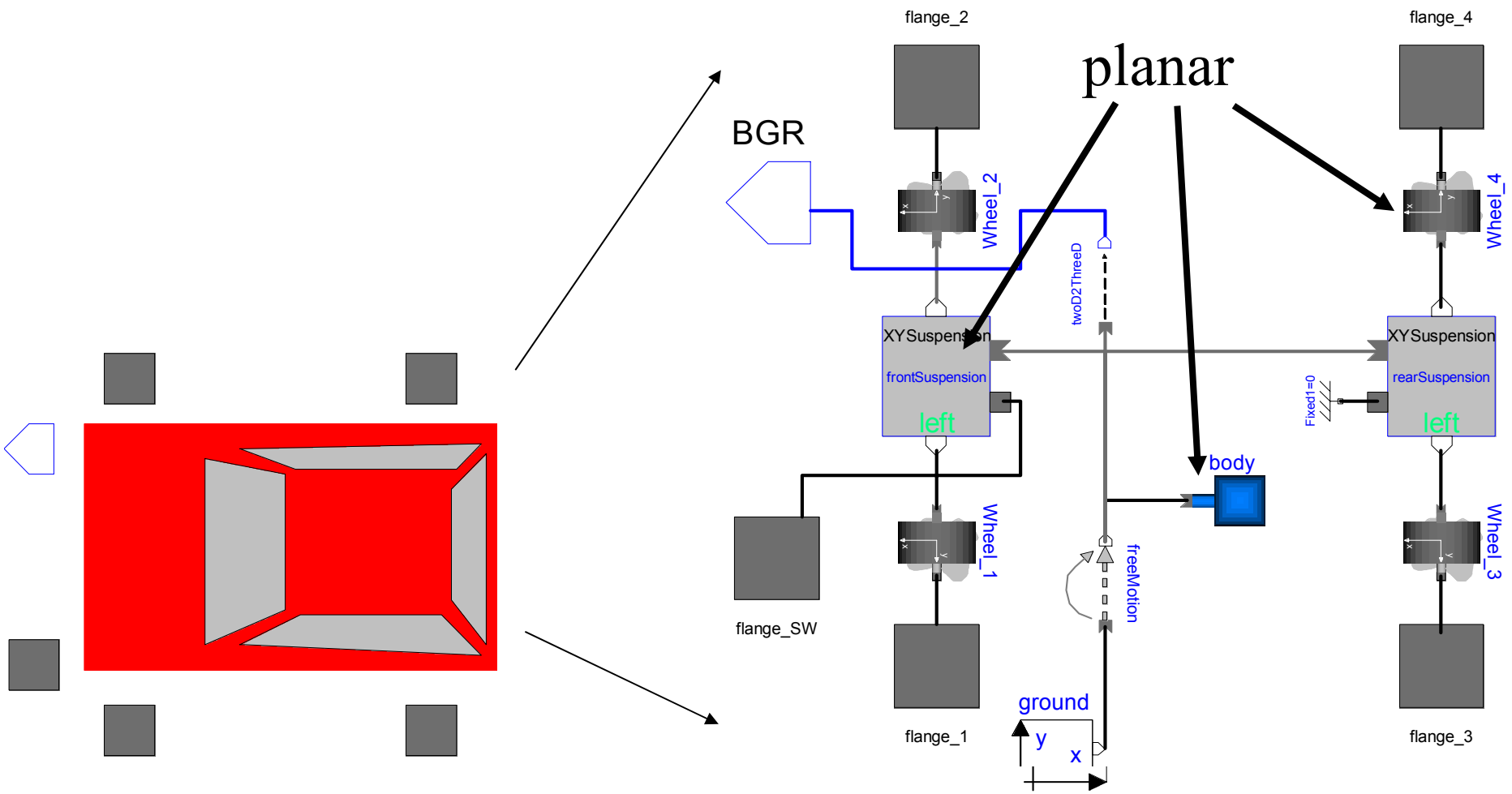
Extended flexibility

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

Different models share same interface



Different models share same interface

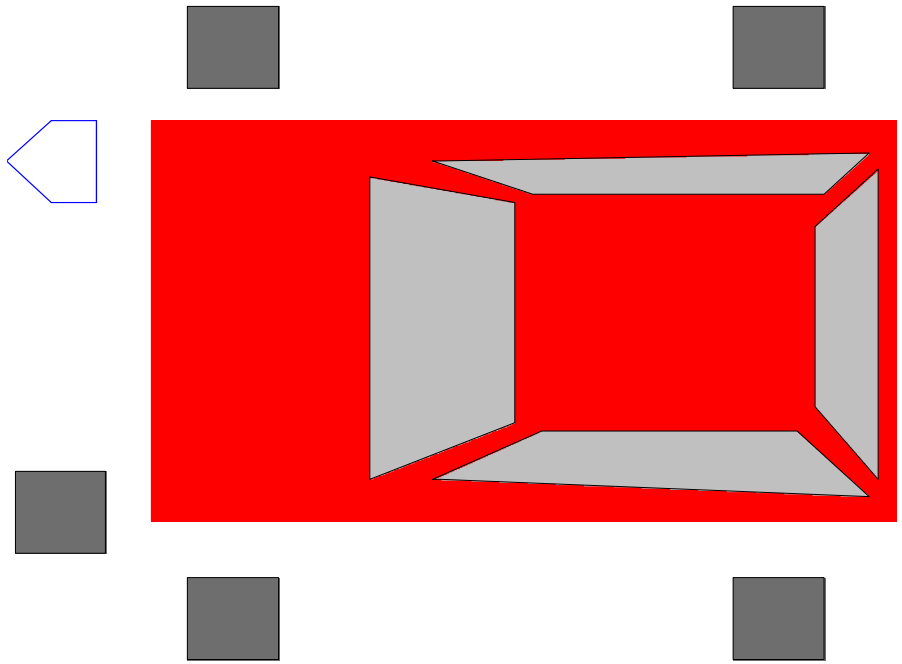


Extended flexibility

- Different models share same interface.
  - Model focus/viewpoint can be changed easilly!
  - Higher requirements on interfaces!

Suitable interfaces?

four wheel steering?



Active suspension?

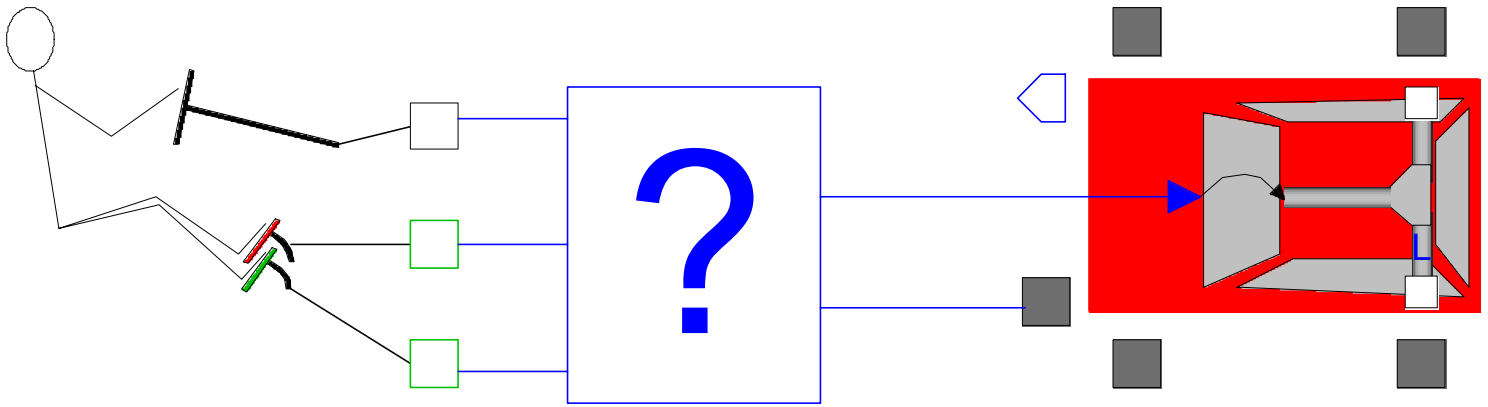
Extended flexibility

- 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

X-by wire?

Fuel cell technology?



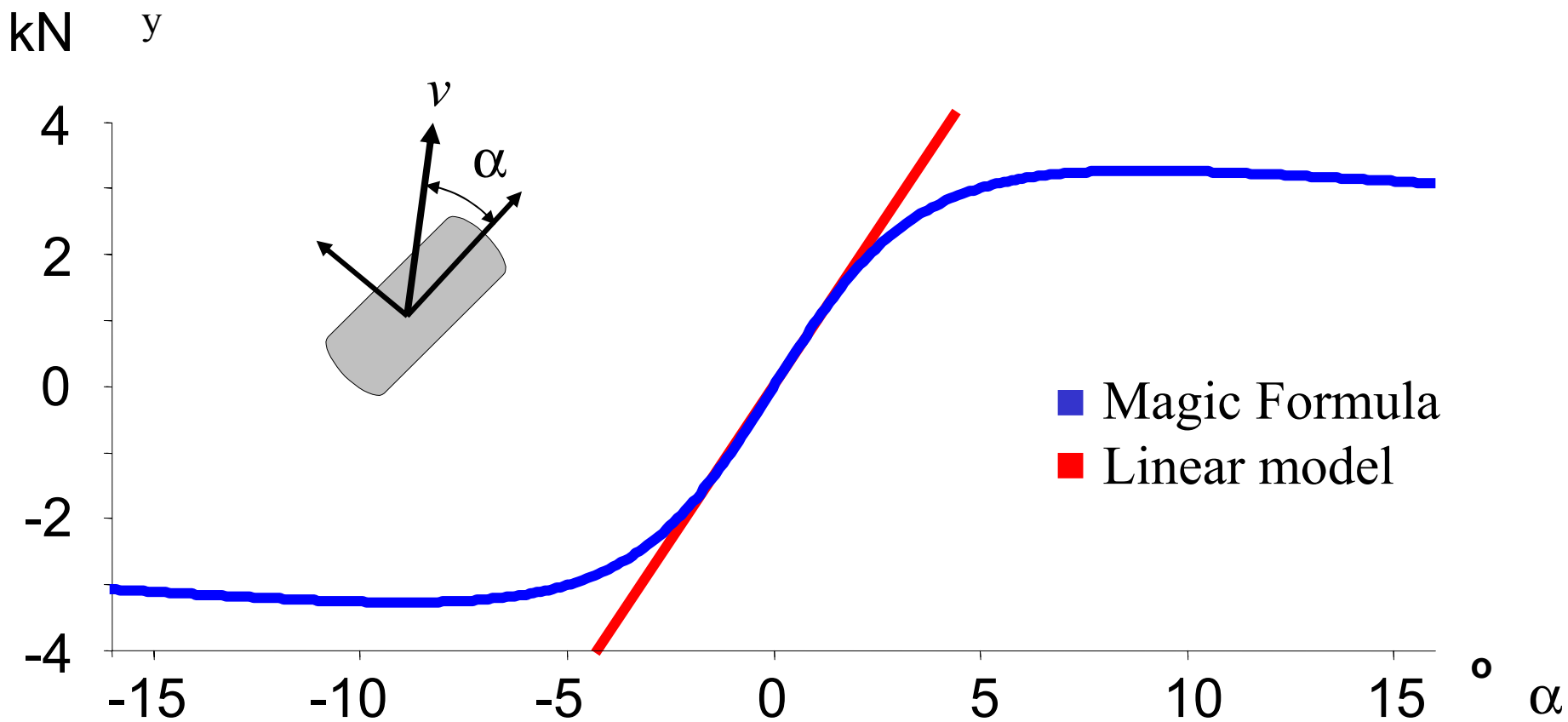
Vehicle dynamics control systems?

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!



Acknowledgements

- Dynasim AB
- DLR

Contact

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