Training on teaching of car development process with an illustration of ergonomics and simulations
What is Adams?

• **Automatic Dynamic Analysis of Mechanical Systems**
• **Development started in 1974 at the University of Michigan**
• **Mechanical Dynamics, Inc. started with Adams/Solver**
• **MDI was acquired by MSC in 2002**
Adams Modules in version 2014

- Adams/Solver
- Adams/View
- Adams/PostProcessor
- Adams/Flex
- Adams/ViewFlex
- Adams/Durability
- Adams/Vibration
- Adams/Controls
- Adams/Exchange
- Adams/Tire FTire
- Adams/Insight
- Adams/Car
- Adams/Machinery
Adams/Car

- Main toolbar
- Main window
- Model browser
- Status toolbar
Adams/Car - advantages

• Database structure
• Prepared templates
• Quick and easy vehicle components changes
• Predefined vehicle maneuvers
• Incorporated flexibility of bodies
• Taylored for vehicle simulations
Adams/Car – database structure

- All projects are organized in databases
- One database prepared by MSC, with sample models
Adams/Car – templates

- Adams/Car contains around 25 prepared templates
- All necessary components of vehicle are prepared
Adams/Car – data workflow

Assemblies

Subsystems

Templates
Adams/Car – data workflow

- **Templates** - Defines vehicle sub-assemblies topology (that is, how the parts and joints fit together in the model, how information is transmitted, and so on). For example, a template could be a suspension type, which can be defined either as front and/or rear.

- **Subsystems** - A mechanical model that references a template and tailors it by supplying parameters that adjust the template (for example, locations that define part dimensions and spring stiffness). These models are usually a major system of your vehicle, for example, front suspension, steering system, and body.

- **Assemblies** - A list of subsystems and a single test rig combined in a vehicle or suspension assembly. A test rig is necessary to provide an actuation, in your model, for analysis.
Adams/Car – subsystem

Points
Part properties
Spring, damper, bushing properties

Subsystem
Adams/Car – assemblies

- Suspension assembly
- Full vehicle assembly
- General actuations assembly
- Fourpost assembly (Adams/Car Ride plugin)
- Component assembly (i.e. Tyre analysis)
Adams/Car – assemblies

- Suspension assembly

Suspension subsystem + Steering subsystem + Other subsystem + Test rig = Suspension assembly
Adams/Car – assemblies

- Suspension assembly
Adams/Car – assemblies

- Full vehicle assembly

- Front suspension subsystem
- Rear suspension subsystem
- Body subsystem
- Powertrain subsystem
- Brake subsystem
- Front wheels subsystem
- Rear wheels subsystem
- Steering subsystem
- Other subsystem
- Test rig

= Full vehicle assembly
Adams/Car – assemblies

• Full vehicle assembly
Adams/Car – assemblies

- Fourpost assembly (Adams/Car Ride plugin)
Adams/Car – simulation

- Interconnection between Adams modules

Adams/Car
- .adm file
- .acf file

Adams/Solver
- .msg file
- .req file
- .res file
- .gra file
- .out file

Adams/Postprocessor
Adams/Car – suspension simulation

- Data workflow during suspension simulation
Adams/CAR – suspension simulation

Types of simulation
- Quasi static simulations
- Dynamic simulations

Quasi static simulation
- Wheel travel analysis
- Steering analysis
- Roll and vertical force analysis
- Static load
Adams/Car – suspension simulation

Quasi static simulation

• Opposite wheel travel

Bound 100 mm
Rebound -100 mm
Adams/Car – suspension simulation

Quasi static simulation

- Steering

Upper steering limit -360 deg
Lower steering limit -360 deg
Adams/Car – suspension simulation

Dynamic simulation

STEP (x, x0, h0, x1, h1)
STEP(time,2,0,4,100)
Adams/Car – suspension simulation

Static load

Wheel vertical force 0-2500N
Adams/Car – suspension simulation

Outputs from simulations

• Data of parts of assembly
• Data of joints, springs, dampers, bushing
• Testrig data
• 25 suspension characteristic of non steerable suspension
• 11 suspension characteristic of steerable suspension

Help file
Adams/Car – full assembly simulation

• Data workflow during full assembly simulation
Adams/Car – full assembly simulation

- Vehicle maneuvers are carried out with Driving machine
Adams/Car – full assembly simulation

Types of simulation
- Dynamic simulations
- Static and quasi static maneuvers
- Adams/Smart Driver

Dynamic simulations
- Open loop steering events
- Cornering events
- Course events
- Roll stability events
Adams/Car – full analysis simulation

Course events - ISO lane change

- ISO-3888: Double Lane Change

Vehicle speed 100 km/h
Adams/Car – full analysis simulation

Course events – 3D course
• 3D road with artificial obstacles

Vehicle speed 30 km/h
Adams/Car – full analysis simulation

Adams/Car Truck plugin
Adams/Car – full analysis simulation

Open loop steering event– single lane change

Vehicle speed 80 km/h
MSC Software licences and knowledgeware

• **Students editions**

• **Students competitions**

• **Academic motion bundle**

• **Academic learning center**

• **Adams Tutorial Kit for Mechanical Engineering Courses**

**Adams Tutorial Kit**
Modules not maintained by MSC

- Adams/Engine
- Adams/Aircraft
- Adams/Rail

Last versions in Adams 2008. Currently maintained by VI-Grade

http://www.vi-grade.com/
Modules not maintained by MSC
Usage MSC Adams on FME STU

- 150 licenses of Adams 2005
- 2 licenses of Adams 2014
- Unknown number of student licenses

http://atc.sjf.stuba.sk/
THANK YOU FOR YOUR ATTENTION!

jozef.bucha@stuba.sk