Modeling & Simulation of Buggy

using Matlab

We are from …

Haw Keat

Lilin

Yi Hui

URECA

Undergraduate Research Experience on CAmpus

What is Buggy?

- Single-seater vehicles
- Recreational purposes

Golf buggies

picture taken from www.buggymart.com

Copyright TJ Power Sports, LLC 2003

Go Kart

Objectives

- Develop buggy model for testing purposes
- Investigate and characterize the behavior of buggy
  - Comfort level - Suspension system

Why?

Fun! Challenging! Rewarding!

picture taken

picture taken from http://www.smsonline.com/company/simulators.html

perkarts.com

Buggy simulator

Modeli

Jeep Wrangler

One-seater commercial vehicle “Twin”

Project Scope

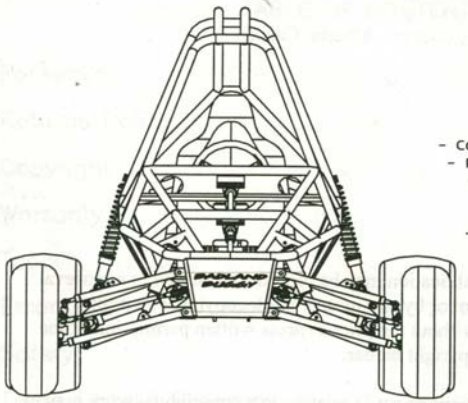
- Matlab/SimMechanics => Buggy model
- Matlab/Virtual Reality Toolbox => Animation
- Solid Edge => CAD drawings
- Design and dimensions of buggy obtained from …

BADLAND BUGGY

Canada

BADLAND BUGGY

3D Off-Road Vehicle Plans & Quality Parts



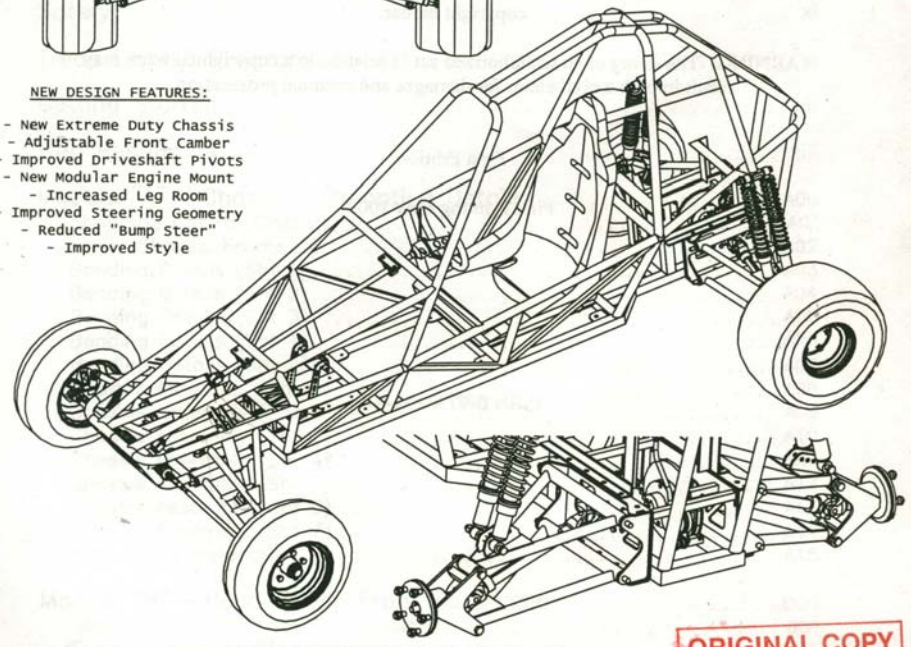
ST2

THIS PLAN SET INCLUDES:

- Metric & S.A.E. Dimensions
- Complete 3D Chassis Construction Details
- Proven Off-Road Steering System Design
- Hydraulic Braking System Details
- Material "Shopping Lists"
- Modular Construction Layout
- All New High-Tech Foot Pedal Boxes
- Web Resources & Internet Links
- More, More, More!

NEW DESIGN FEATURES:

- New Extreme Duty Chassis
- Adjustable Front Camber
- Improved Driveshaft Pivots
- New Modular Engine Mount
- Increased Leg Room
- Improved Steering Geometry
- Reduced "Bump Steer"
- Improved Style



Visit us online at www.badlandbuggy.com
Free Online Technical Support: info@badlandbuggy.com

BADLAND BUGGY
26 Mt Cornwall Circle S.E.
Calgary, Alberta, Canada T2Z 2J6
1-403-880-1793

ISBN 0-9733172-0-5

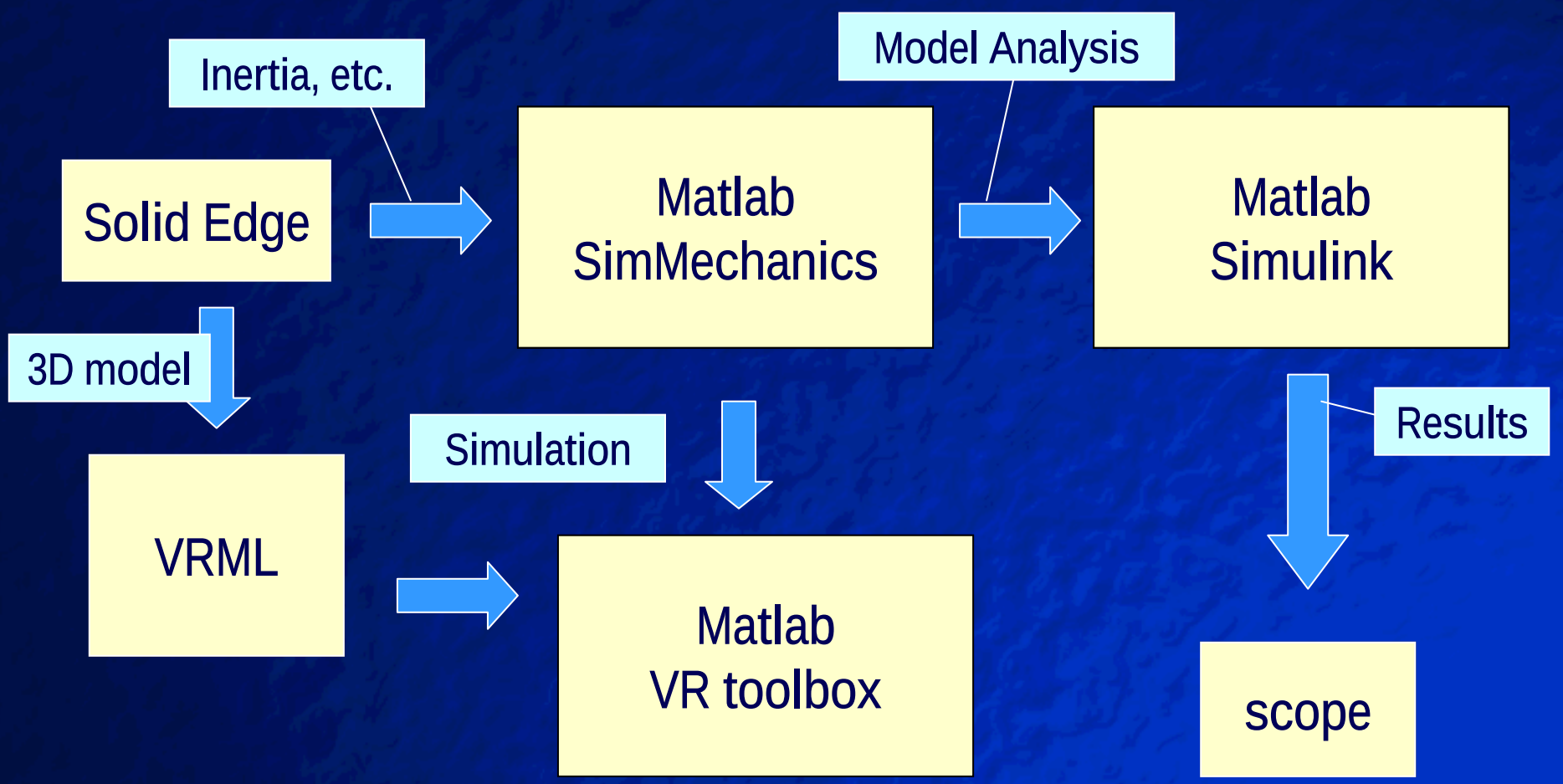
ORIGINAL COPY
AUG 2 6 2003
THIS PLAN SET IS
ORIGINAL IF COLOR "RED"

Badland Buggy

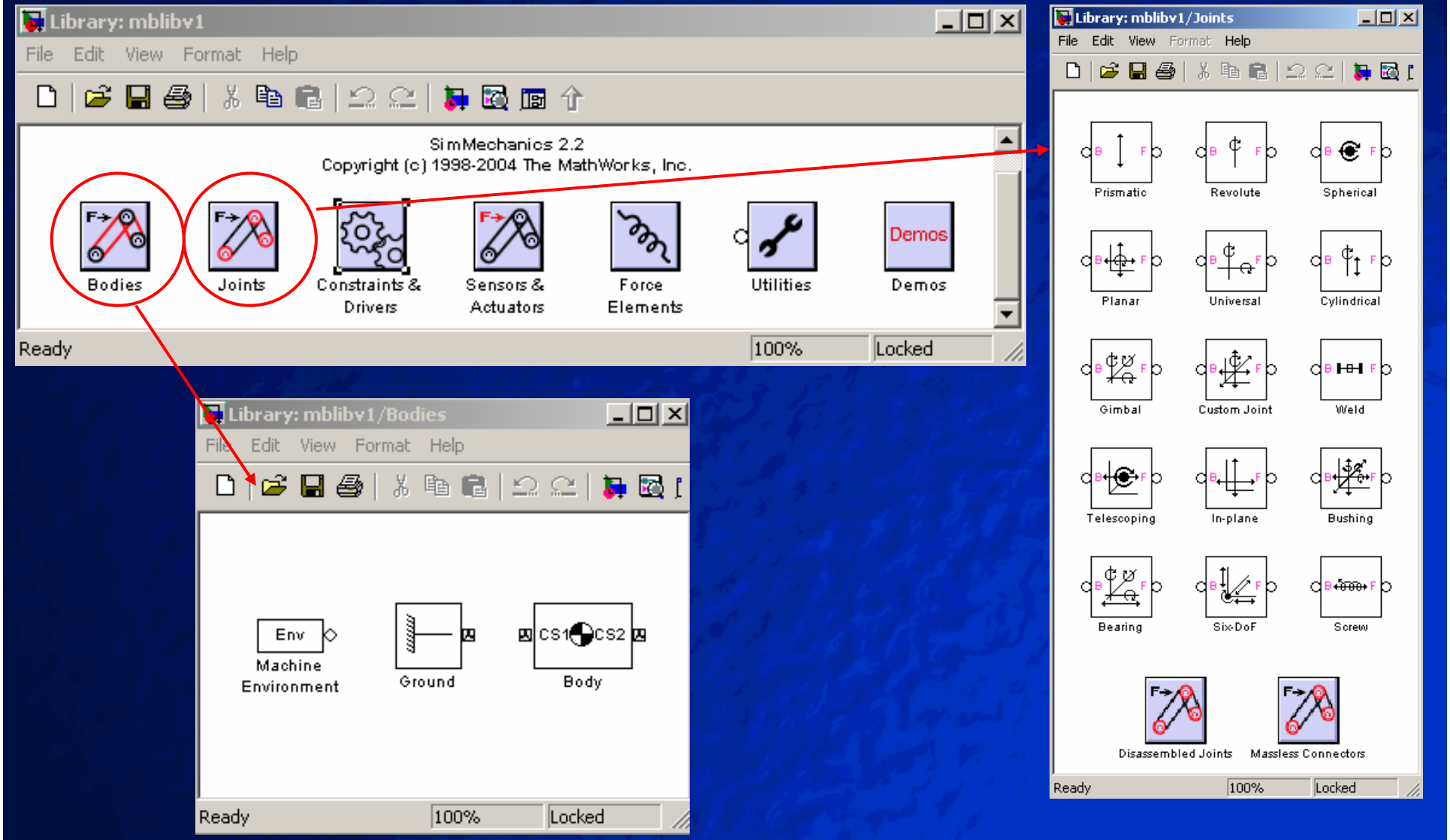
Next …

- Modeling of the buggy using Matlab SimMechanics and Solid Edge
  - Suspension system
  - Driveshaft
  - Wheels
  - Steering
- Animation using VR toolbox
- Solution and Conclusion

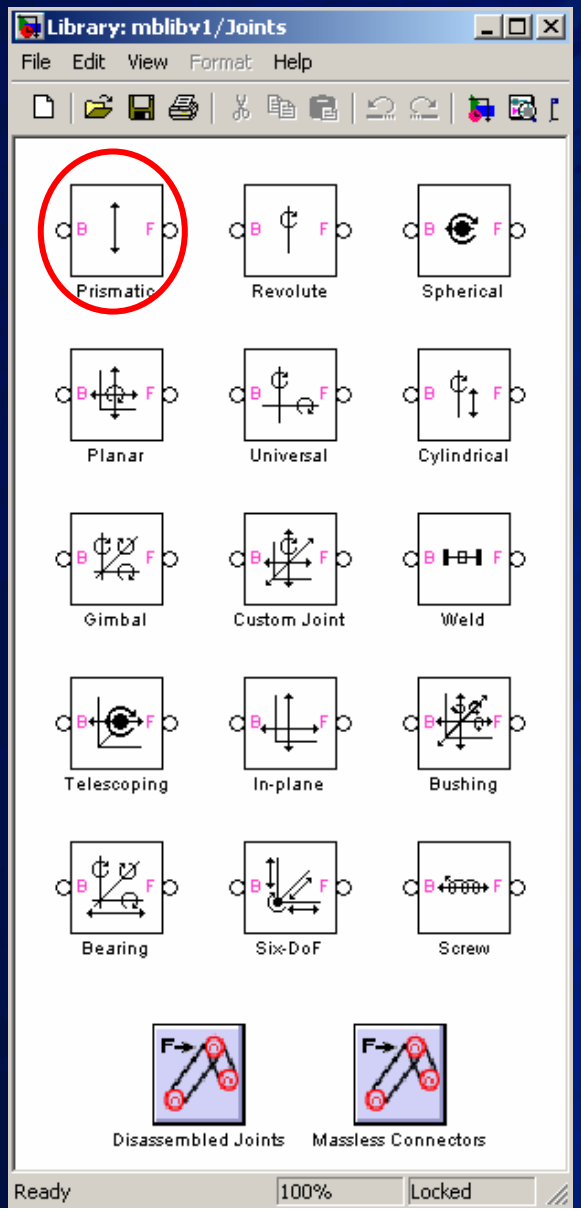
Overview


Inertia, etc.
Model Analysis
Solid Edge
Matlab
SimMechanics
Matlab
Simulink
3D model
Results
Simulation
VRML
Matlab
VR toolbox
scope

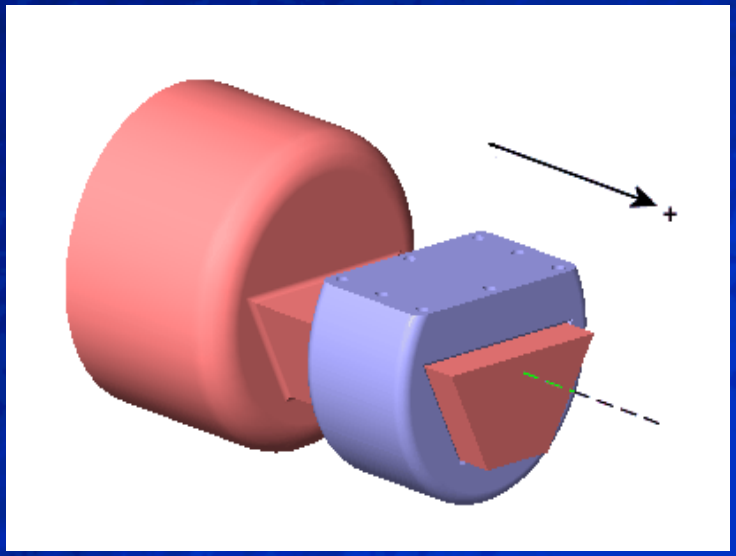
SimMechanics



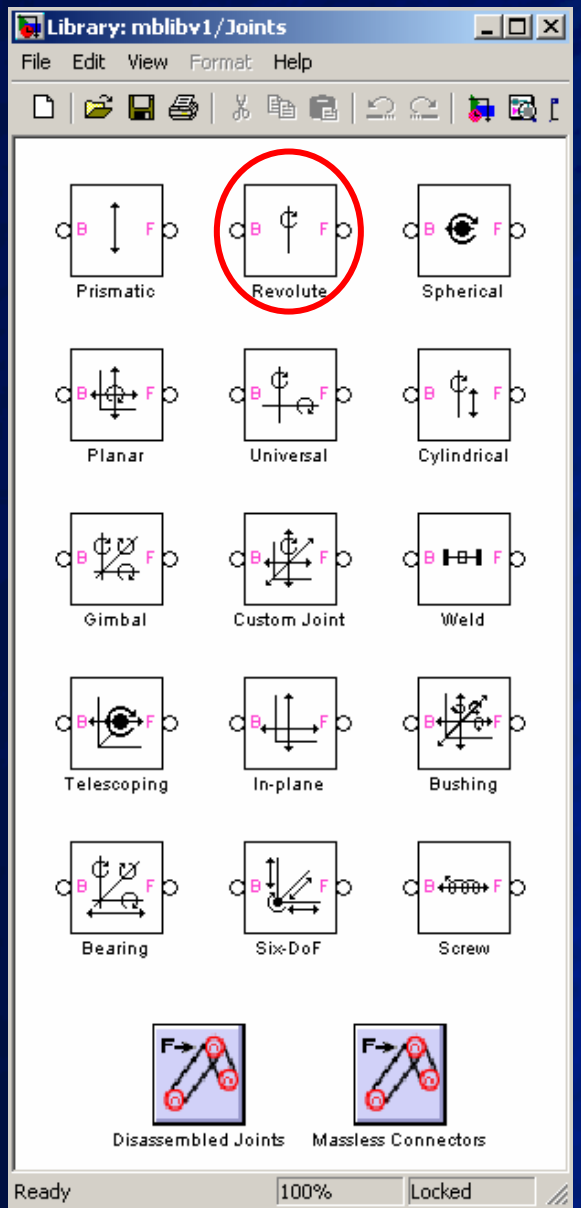
SimMechanics



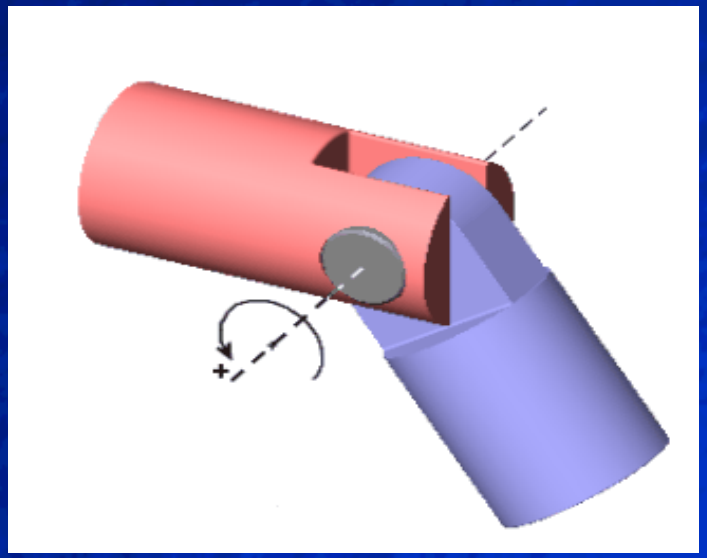
Prismatic joint



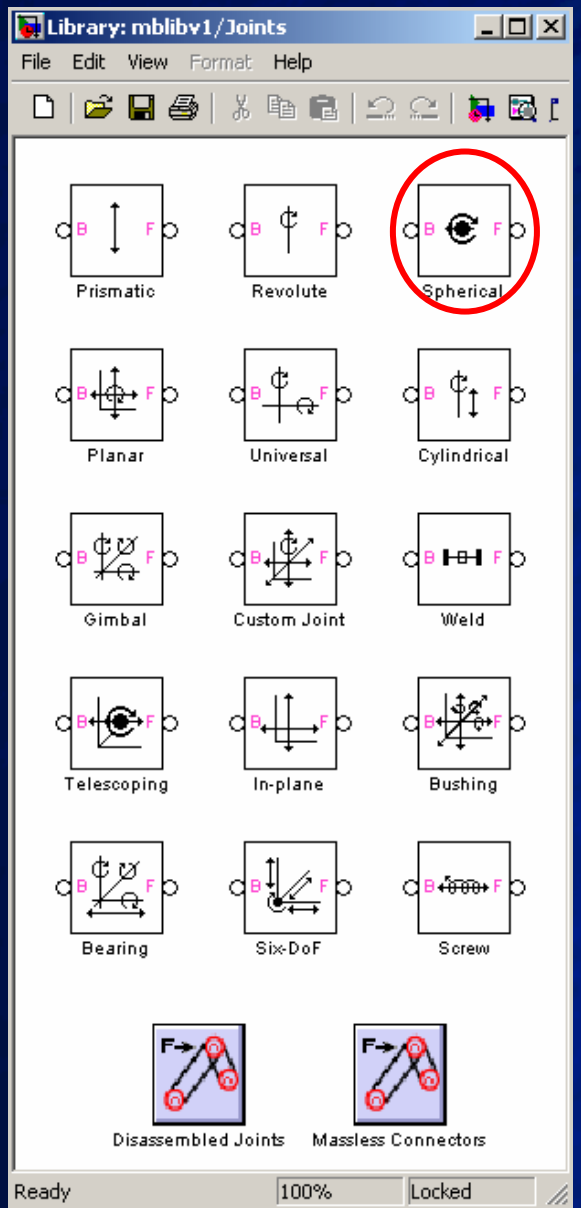
SimMechanics



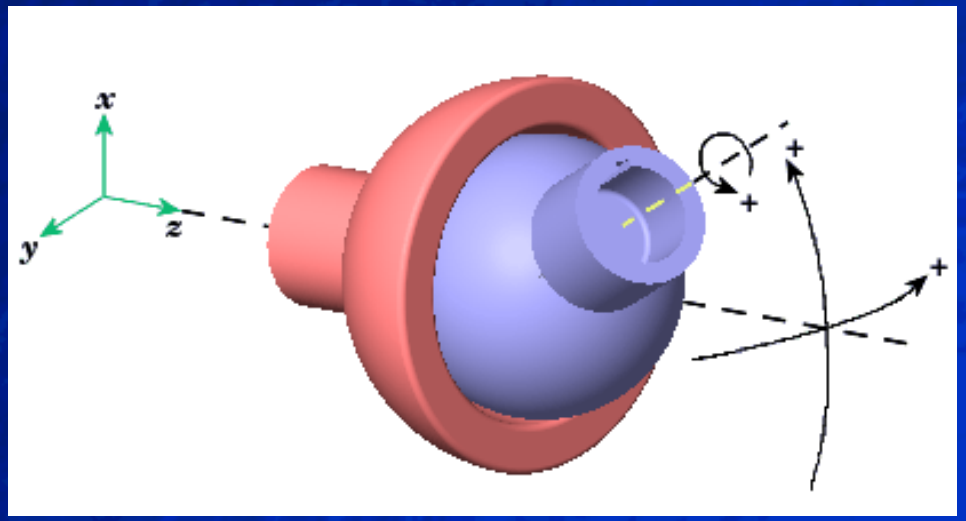
Revolute joint



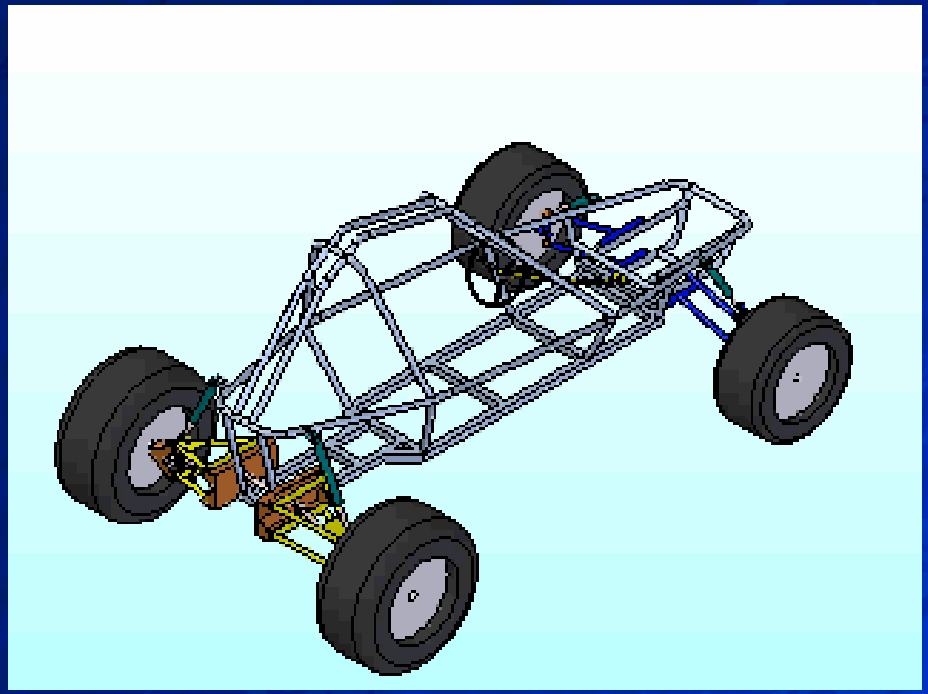
SimMechanics



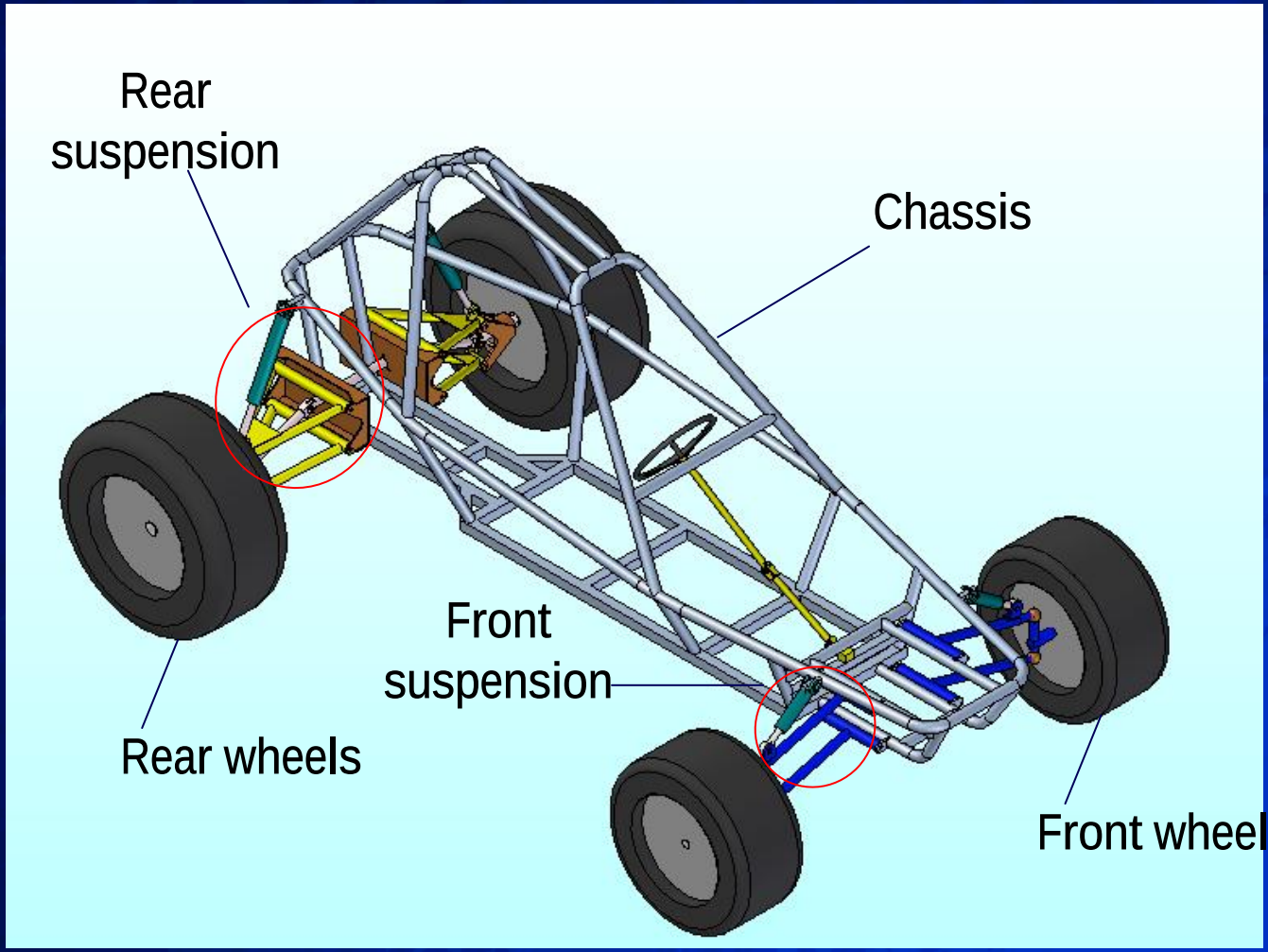
Spherical joint



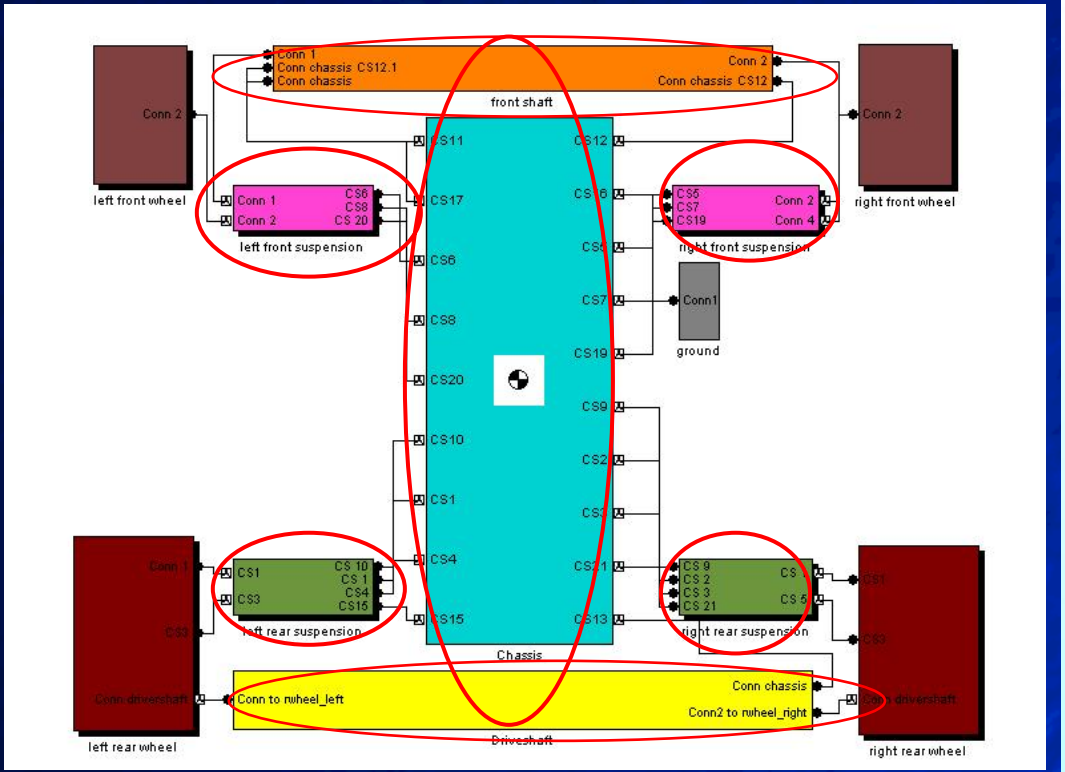
Buggy

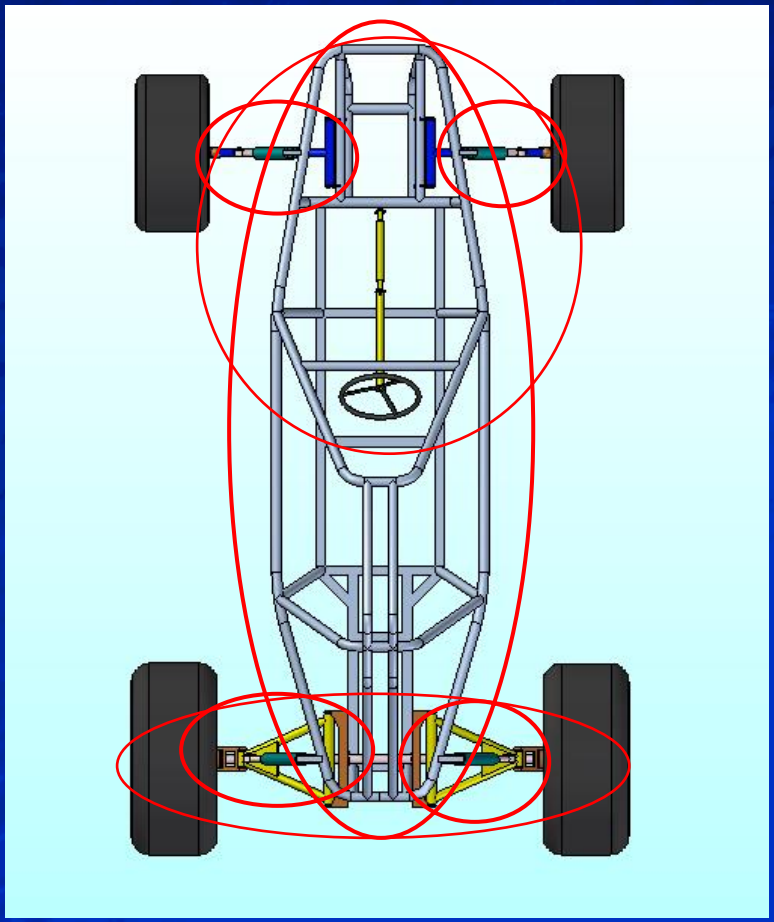


Buggy

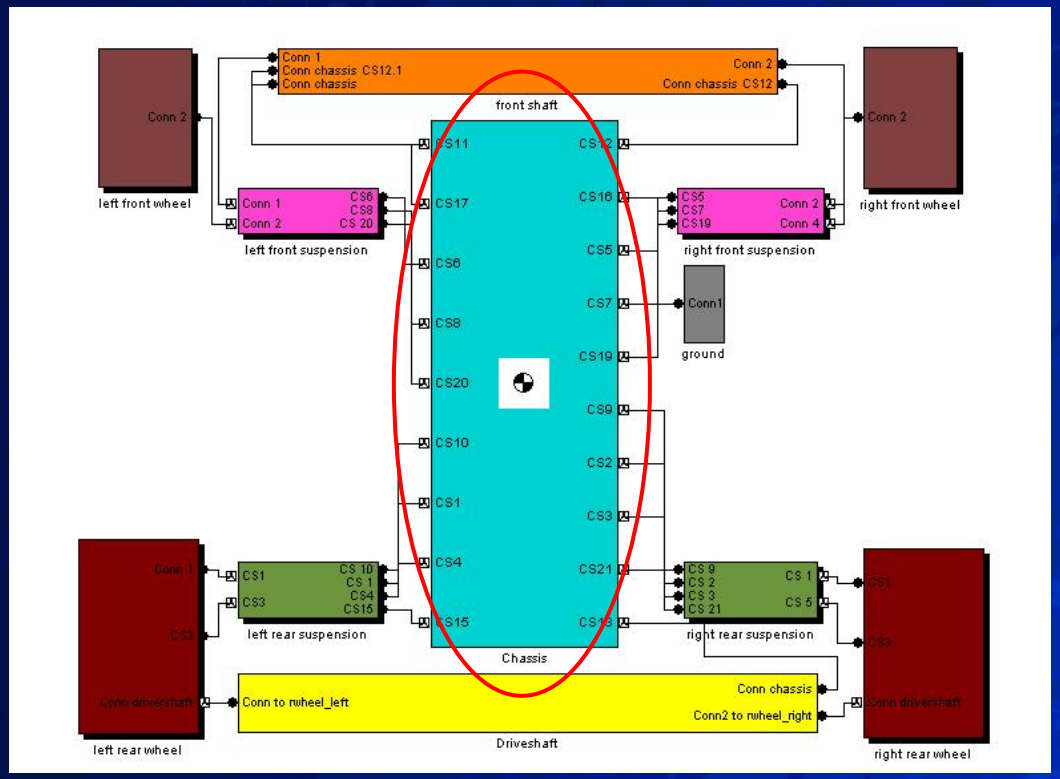

Rear suspension
Chassis
Front suspension
Rear wheels
Front wheels

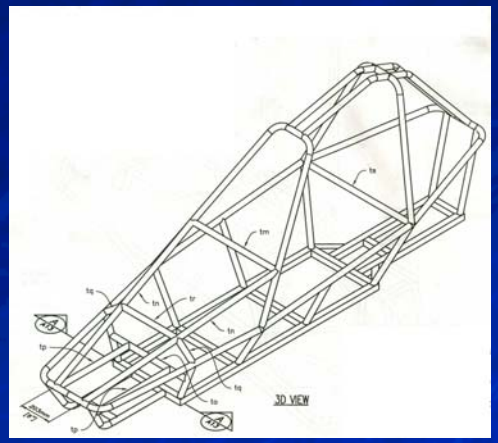
SimMechanics Model of Buggy

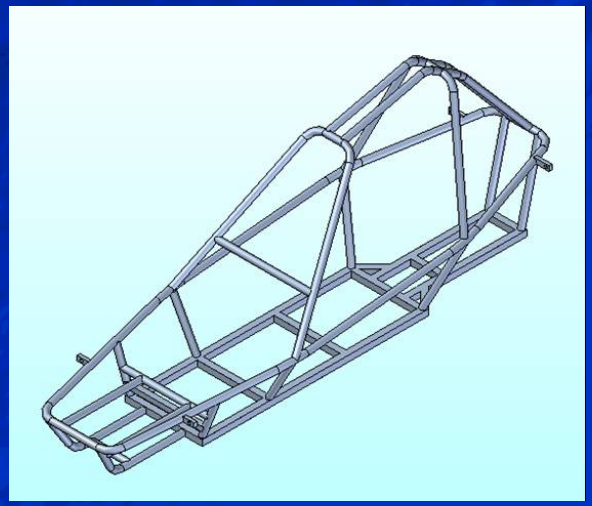




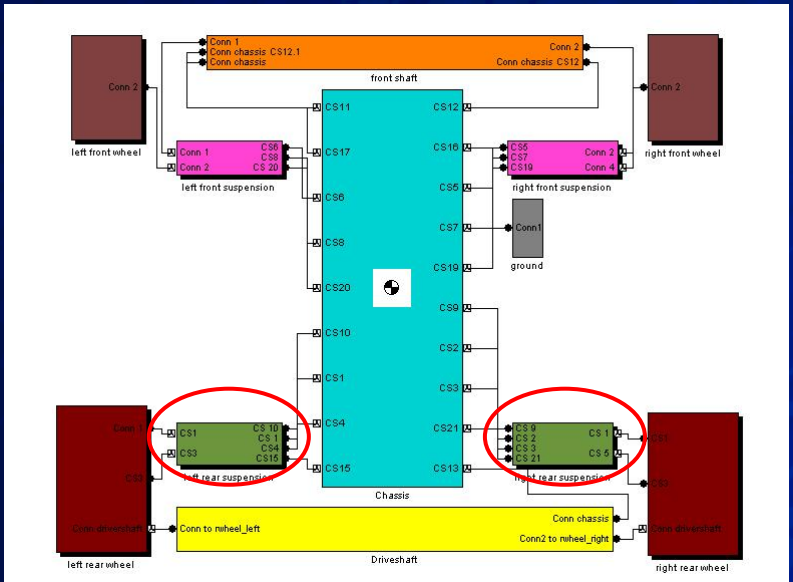
Chassis

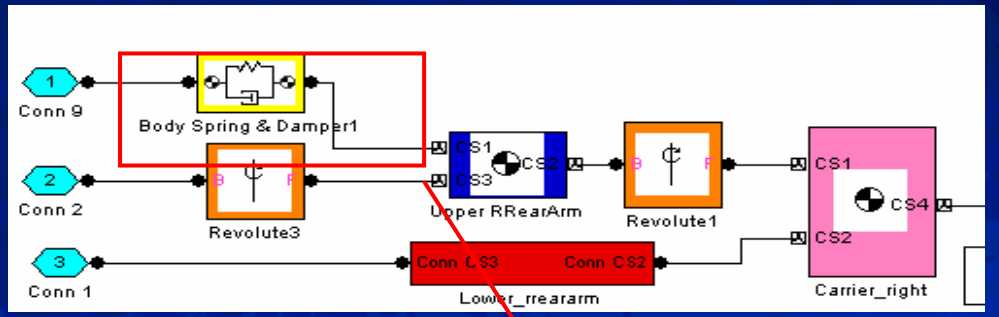

Conn 1
Conn chassis CS12.1
Conn chassis
Conn 2
Conn chassis CS12
front shaft
Conn 2
left front wheel
Conn 1
Conn 2
CS6
CS8
CS 20
left front suspension
CS11
CS17
CS6
CS8
CS20
CS10
CS1
CS4
CS15
CS 2
CS16
CS5
CS7
CS19
CS9
CS2
CS3
CS21
CS13
Chassis
CS5
CS7
CS19
Conn 2
Conn 4
right front suspension
Conn 2
right front wheel
Conn1
ground
Conn 1
CS3
Conn driveshaft
left rear wheel
CS1
CS3
CS 10
CS 1
CS4
CS15
left rear suspension
CS 9
CS 2
CS 3
CS 21
CS 1
CS 5
right rear suspension
CS1
CS3
Conn driveshaft
right rear wheel
Conn to rwheel_left
Conn chassis
Conn2 to rwheel_right
Driveshaft

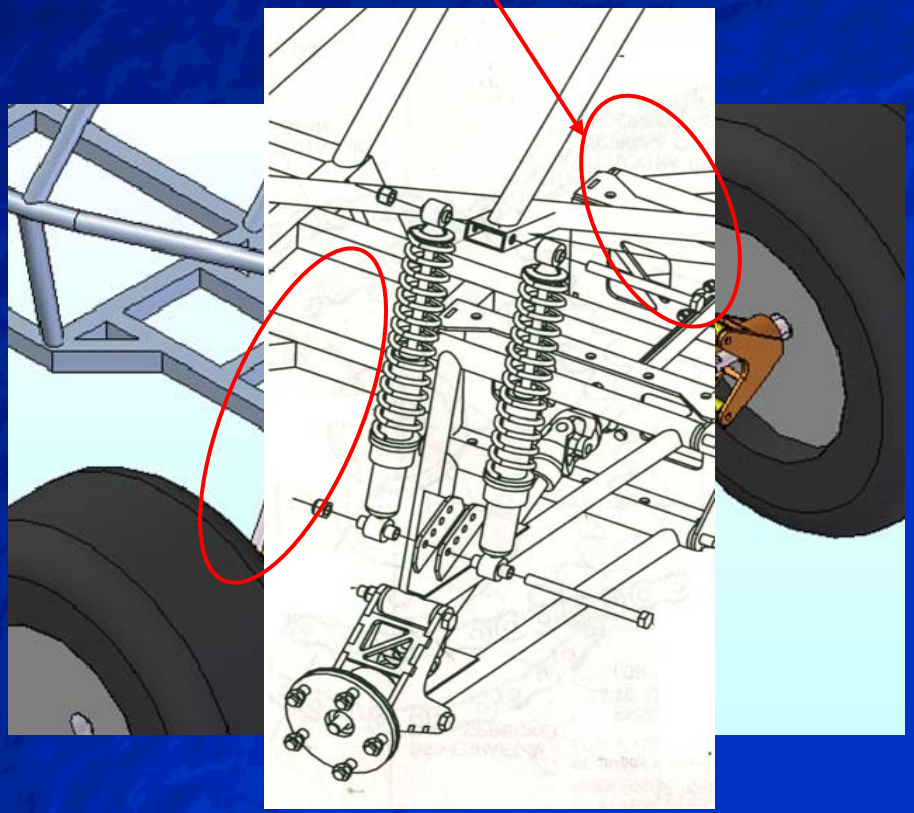

3D VIEW



Rear Suspension







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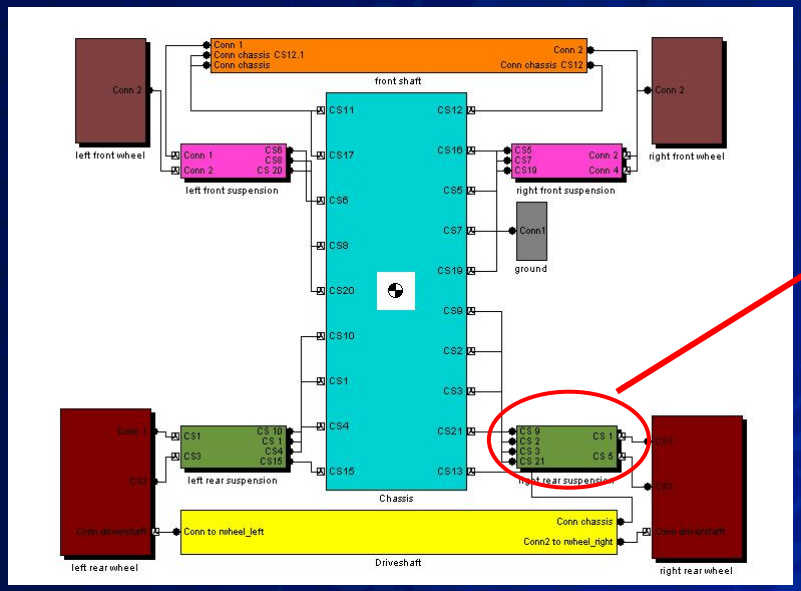
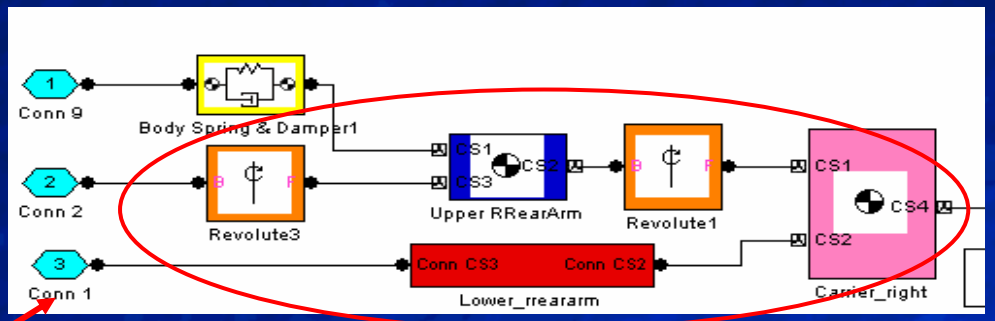
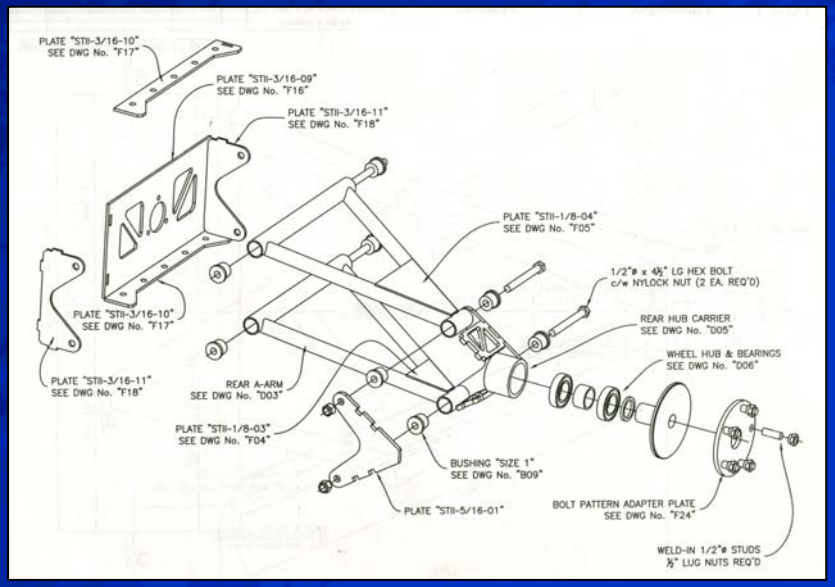
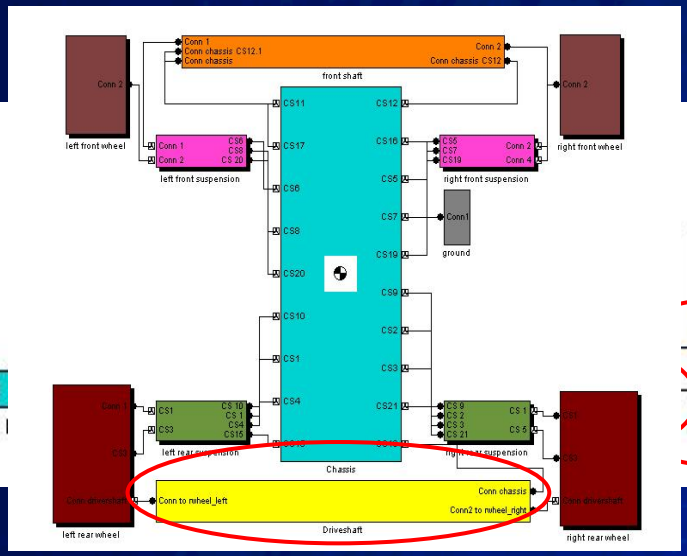
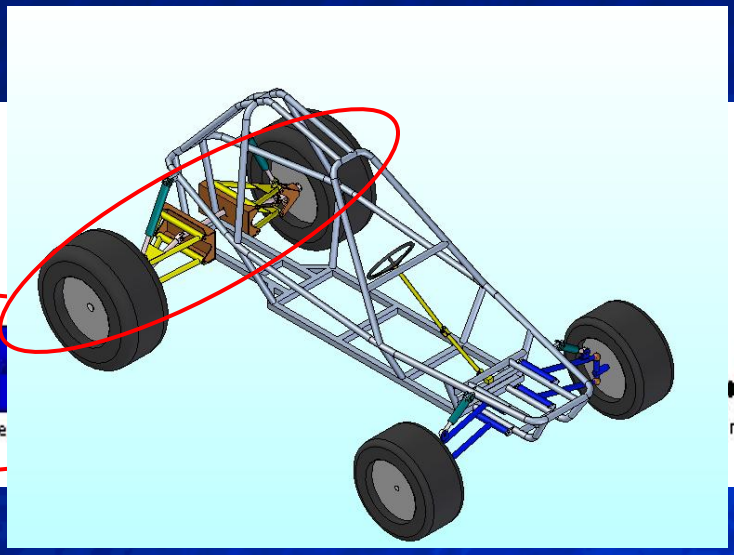


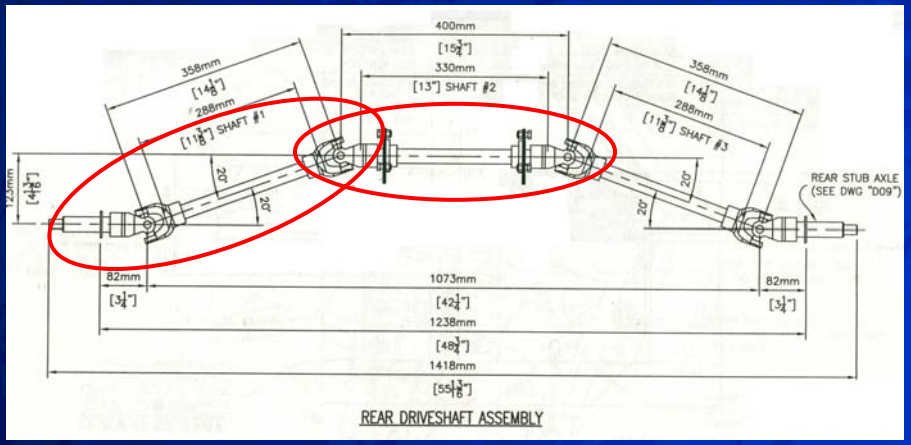




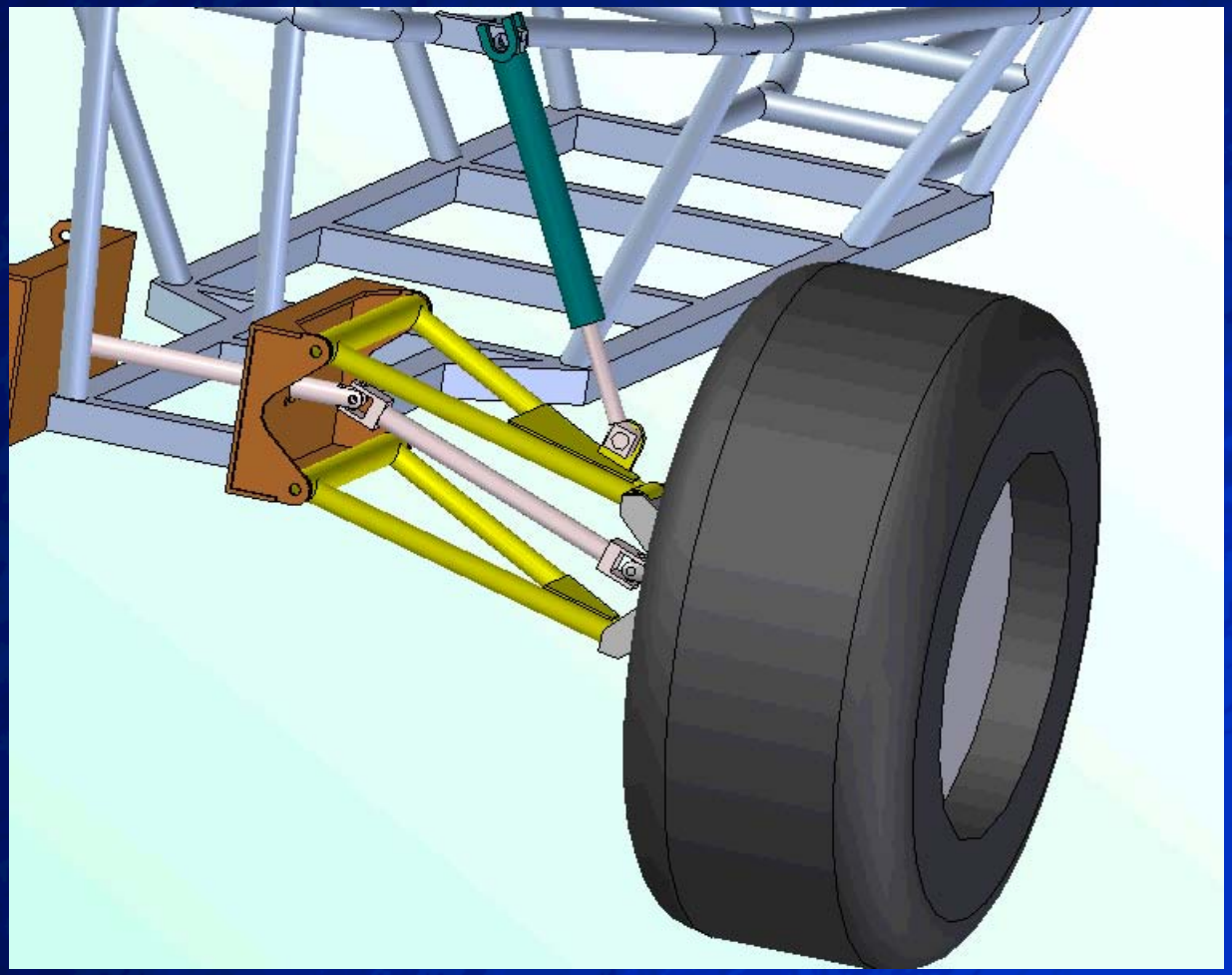
Driveshaft


front shaft
left front wheel
right front wheel
left front suspension
right front suspension
ground
Chassis
left rear wheel
right rear wheel
Conn to rwheel_left
Conn chassis
Conn2 to rwheel_right
Driveshaft

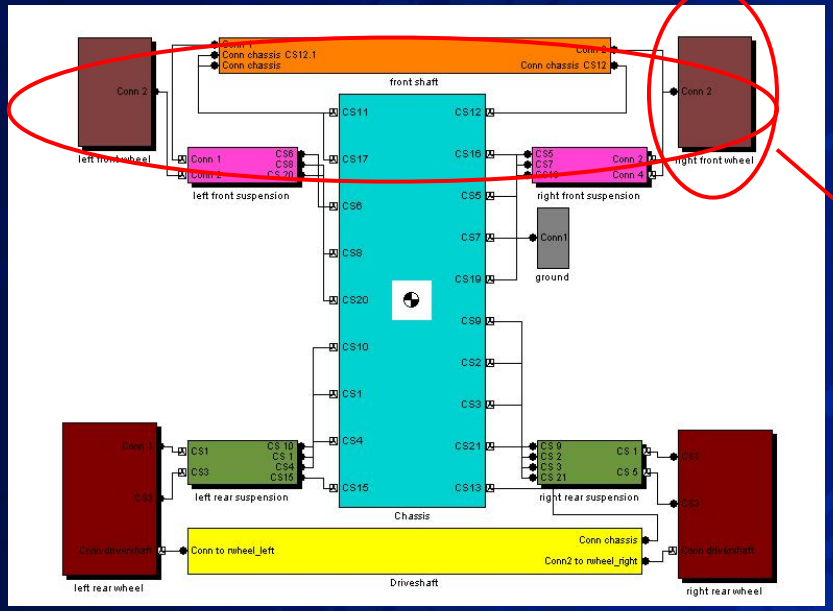


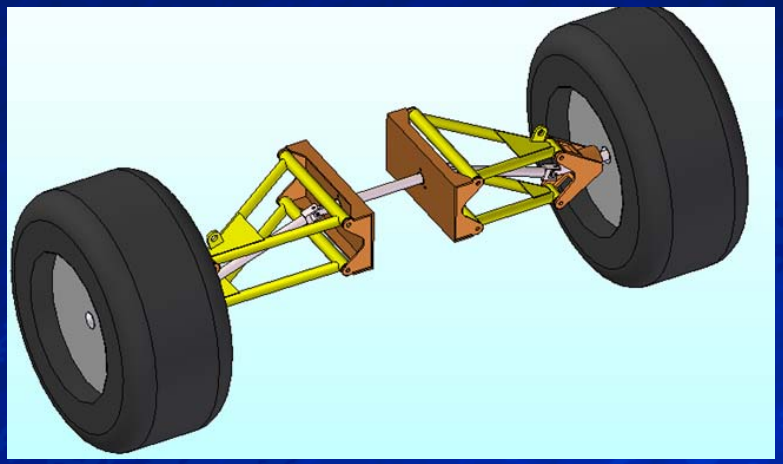

400mm
[15¾"]
330mm
[13"] SHAFT #2
358mm
[14⅛"]
288mm
[11⅜"] SHAFT #1
358mm
[14⅛"]
288mm
[11⅜"] SHAFT #3
20°
20°
20°
20°
123mm
[4⅞"]
REAR STUB AXLE
(SEE DWG "D09")
82mm
[3¼"]
1073mm
[42¼"]
82mm
[3¼"]
1238mm
[48¾"]
1418mm
[55⅞"]
REAR DRIVESHAFT ASSEMBLY

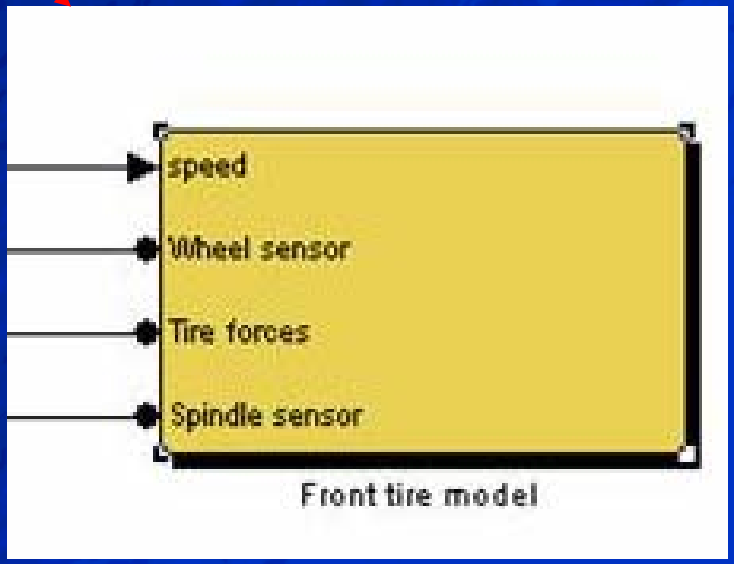
Driveshaft



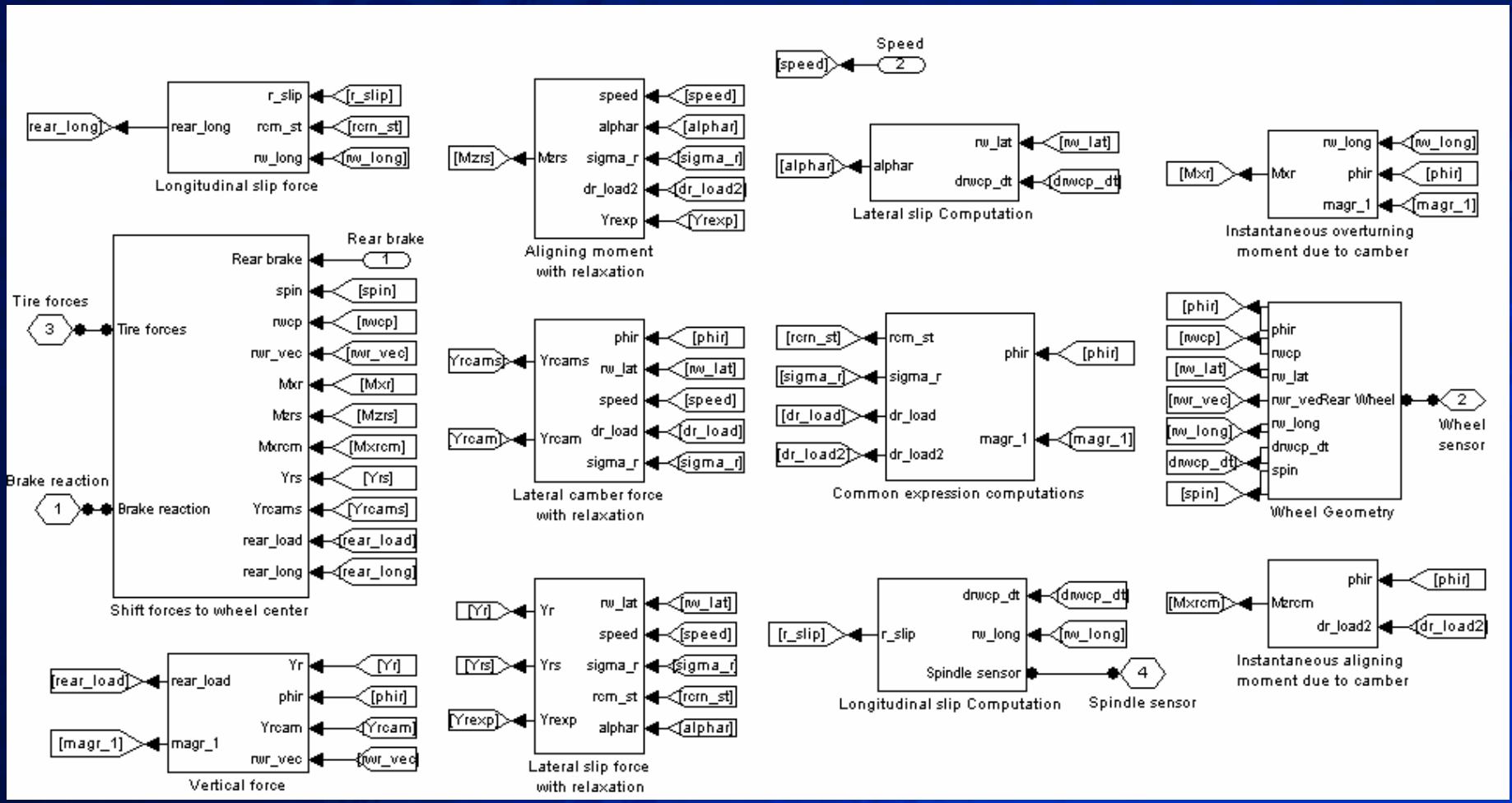
Front & Rear Wheels



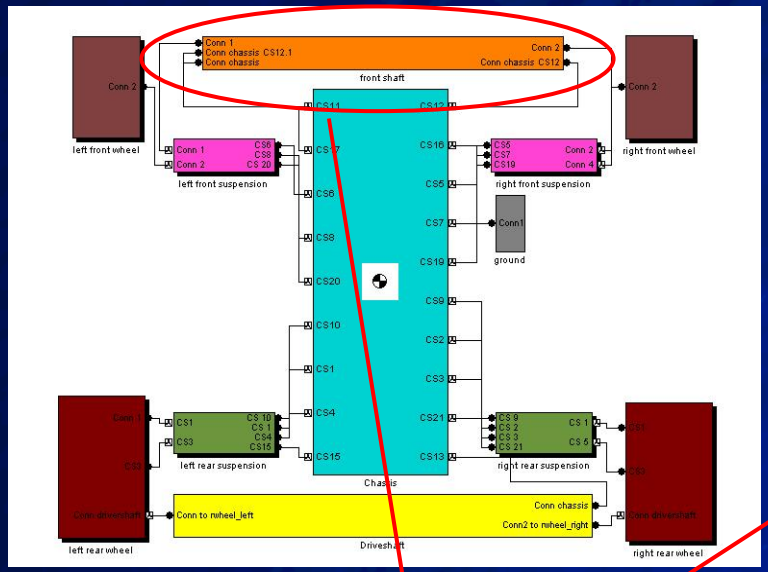


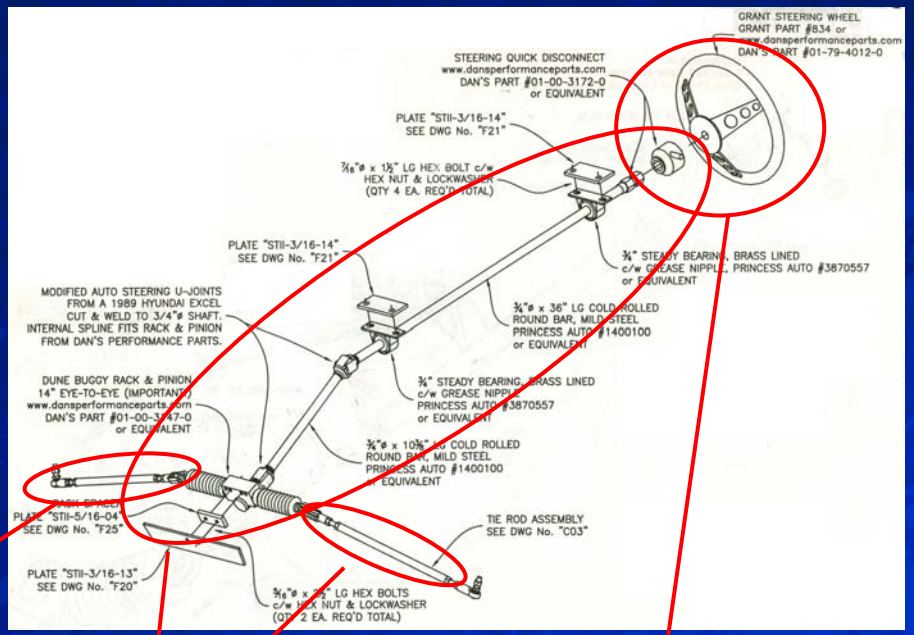


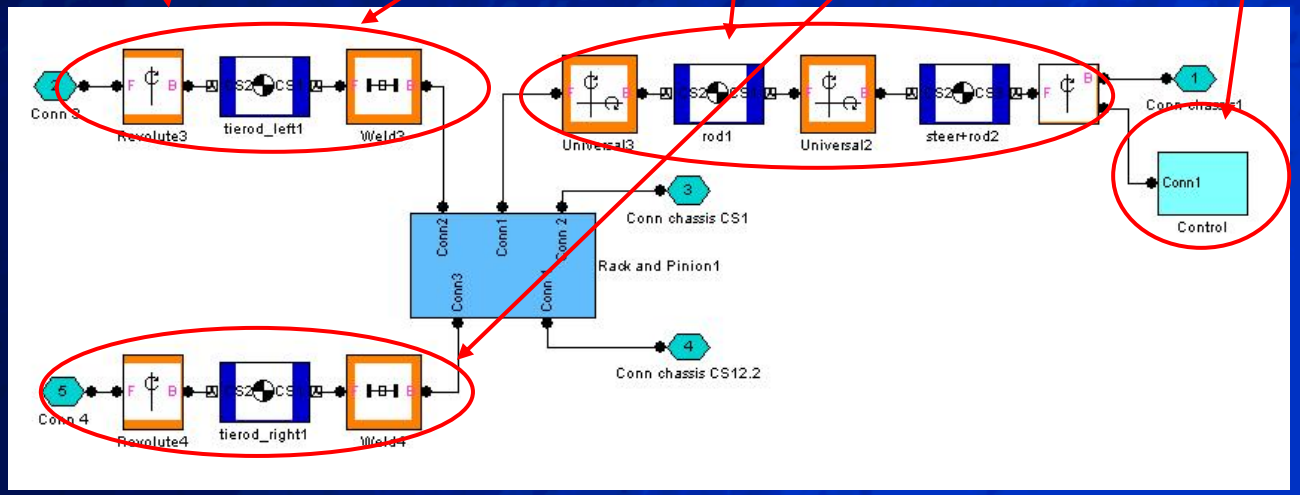
Front & Rear Wheels



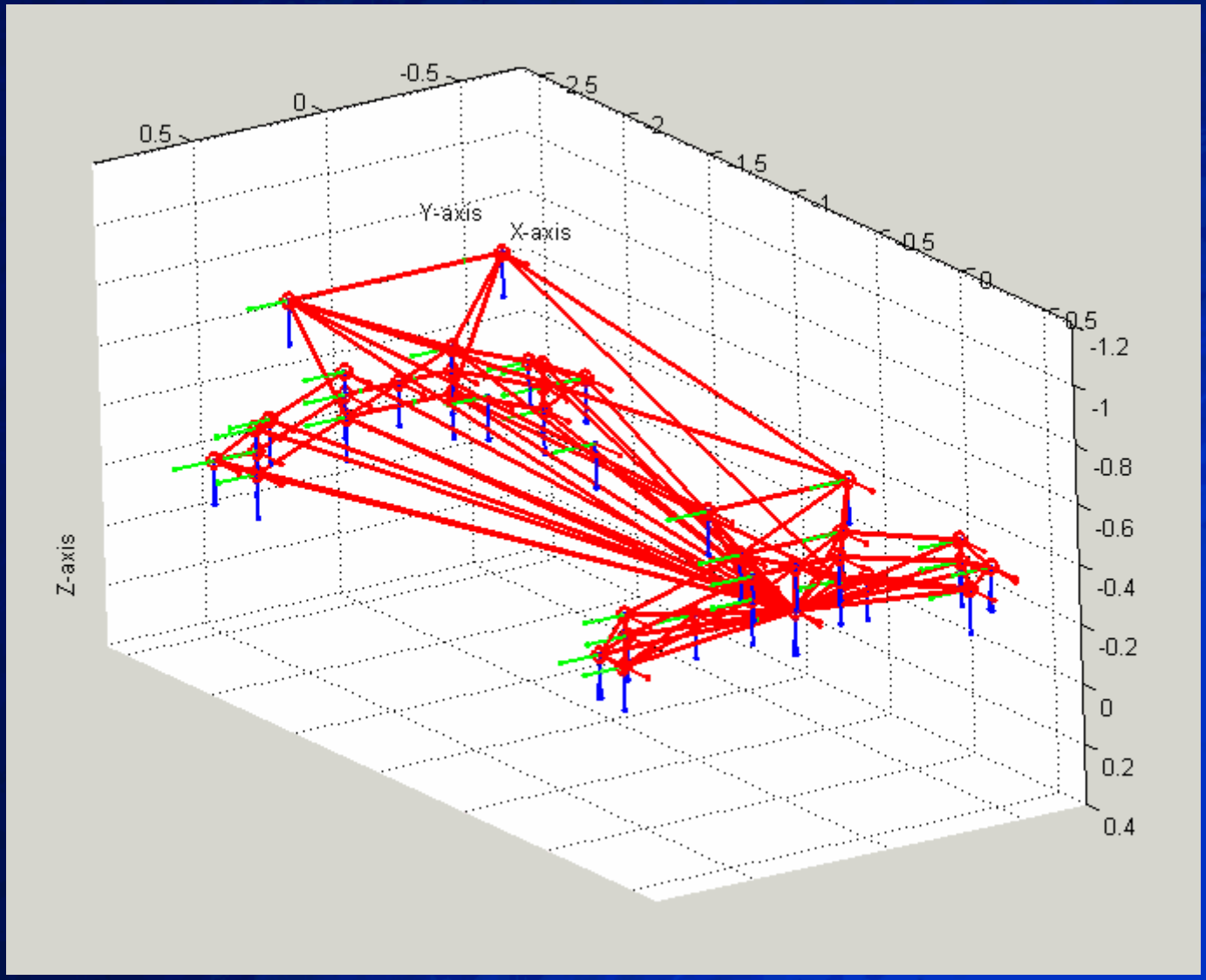
Steering


front shaft
left front wheel
right front wheel
left front suspension
right front suspension
ground
Chassis
left rear suspension
right rear suspension
Conn to rwheel_left
Conn chassis
Conn2 to rwheel_right
Driveshaft
left rear wheel
right rear wheel


GRANT STEERING WHEEL
GRANT PART #834 or
DAN'S PART #01-79-4012-0
STEERING QUICK DISCONNECT
www.dansperformanceparts.com
DAN'S PART #01-00-3172-0
or EQUIVALENT
PLATE "STII-3/16-14"
SEE DWG No. "F21"
HEX NUT & LOCKWASHER
(QTY 4 EA. REQ'D TOTAL)
¾" STEADY BEARING, BRASS LINED
c/w GREASE NIPPLE, PRINCESS AUTO #3870557
or EQUIVALENT
MODIFIED AUTO STEERING U-JOINTS
FROM A 1989 HYUNDAI EXCEL
CUT & WELD TO 3/4"ø SHAFT.
INTERNAL SPLINE FITS RACK & PINION
FROM DAN'S PERFORMANCE PARTS.
ROUND BAR, MILD STEEL
PRINCESS AUTO #1400100
or EQUIVALENT
DUNE BUGGY RACK & PINION
14" EYE-TO-EYE (IMPORTANT!)
www.dansperformanceparts.com
DAN'S PART #01-00-3147-0
or EQUIVALENT
PRINCESS AUTO #3870557
or EQUIVALENT
ROUND BAR, MILD STEEL
PRINCESS AUTO #1400100
or EQUIVALENT
PLATE "STII-5/16-04"
SEE DWG No. "F25"
TIE ROD ASSEMBLY
SEE DWG No. "C03"
PLATE "STII-3/16-13"
SEE DWG No. "F20"
c/w HEX NUT & LOCKWASHER
(QTY 2 EA. REQ'D TOTAL)


Conn 3
Revolute3
tierod_left1
Weld3
Universal3
rod1
Universal2
steer+rod2
Conn chassis CS1
Rack and Pinion1
Conn chassis CS12.2
Conn 4
Revolute4
tierod_right1
Weld4
Conn1
Control

Simulation



Animation

Solid Edge

VRealm Builder

VR toolbox

Animation

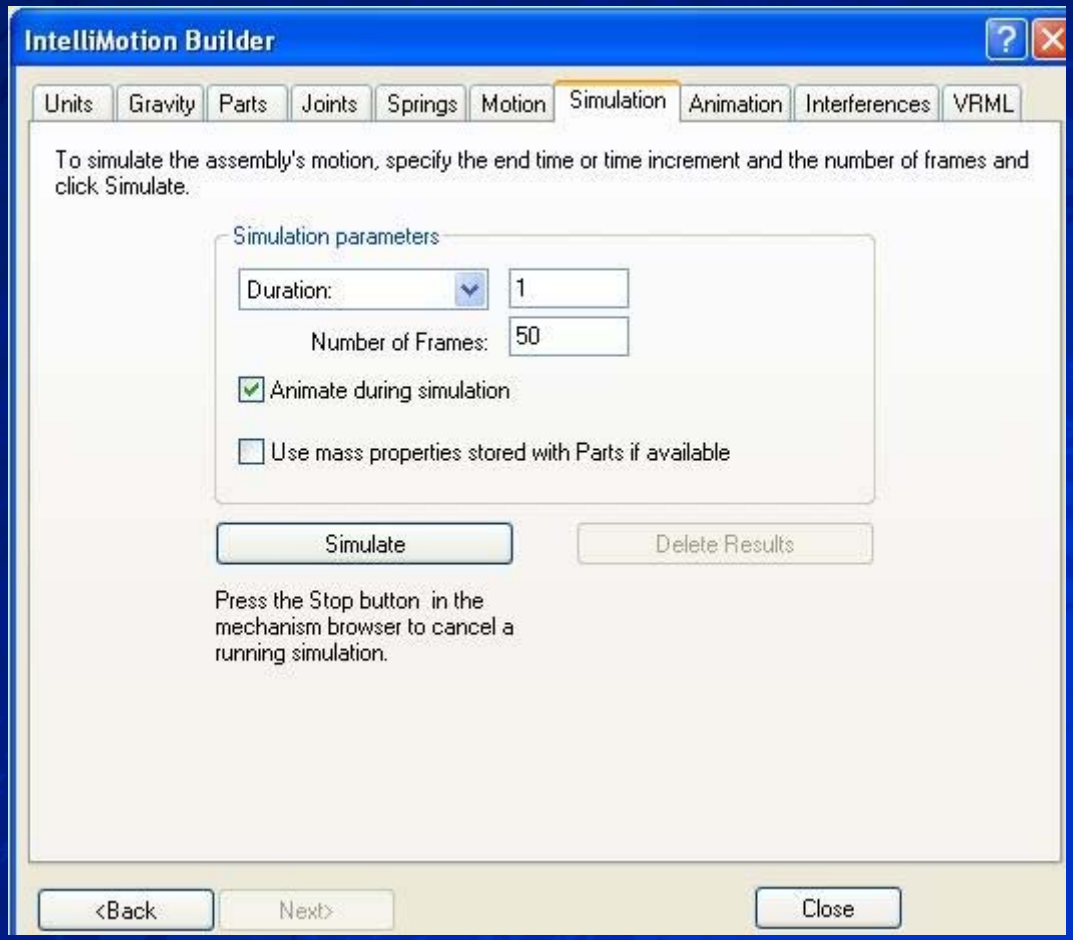
Solid Edge

↓

VRealm Builder

↓

VR toolbox



Animation

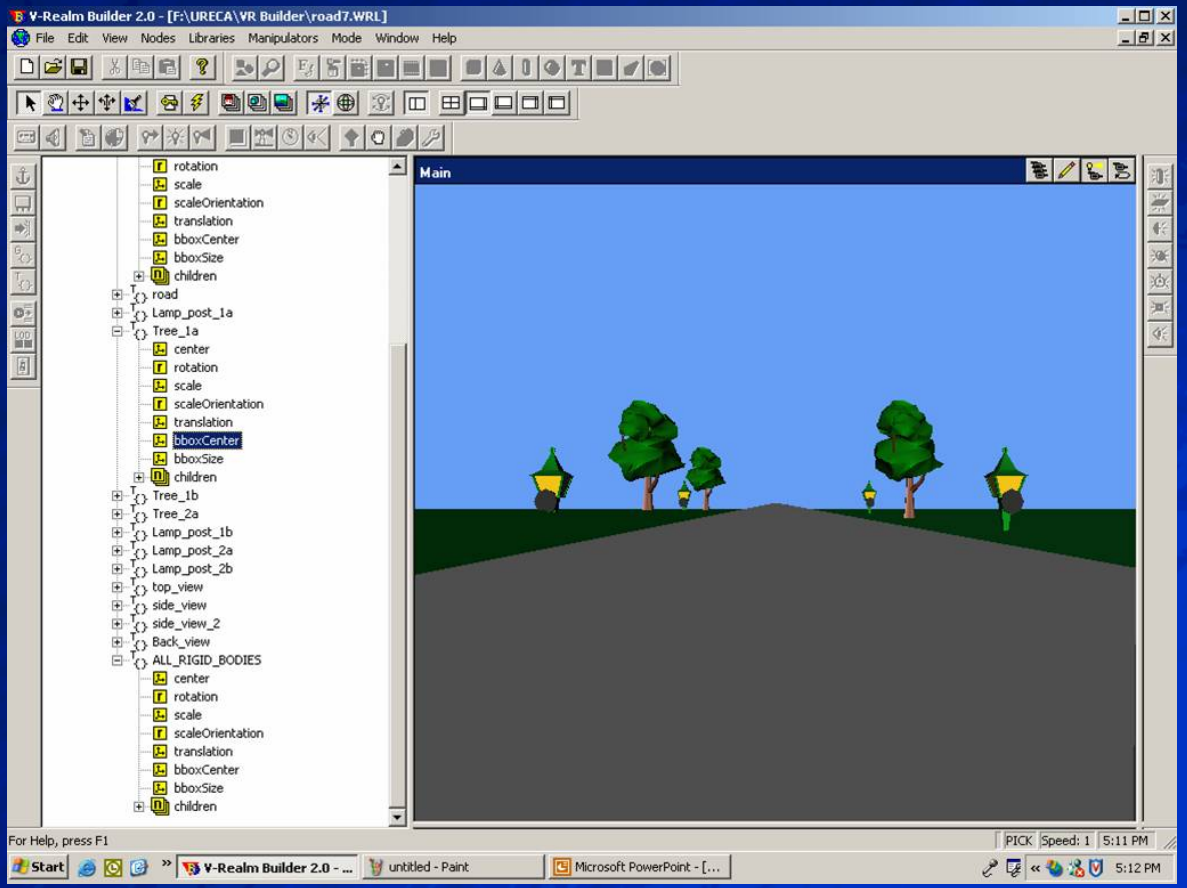
Solid Edge

↓

VRealm Builder

↓

VR toolbox

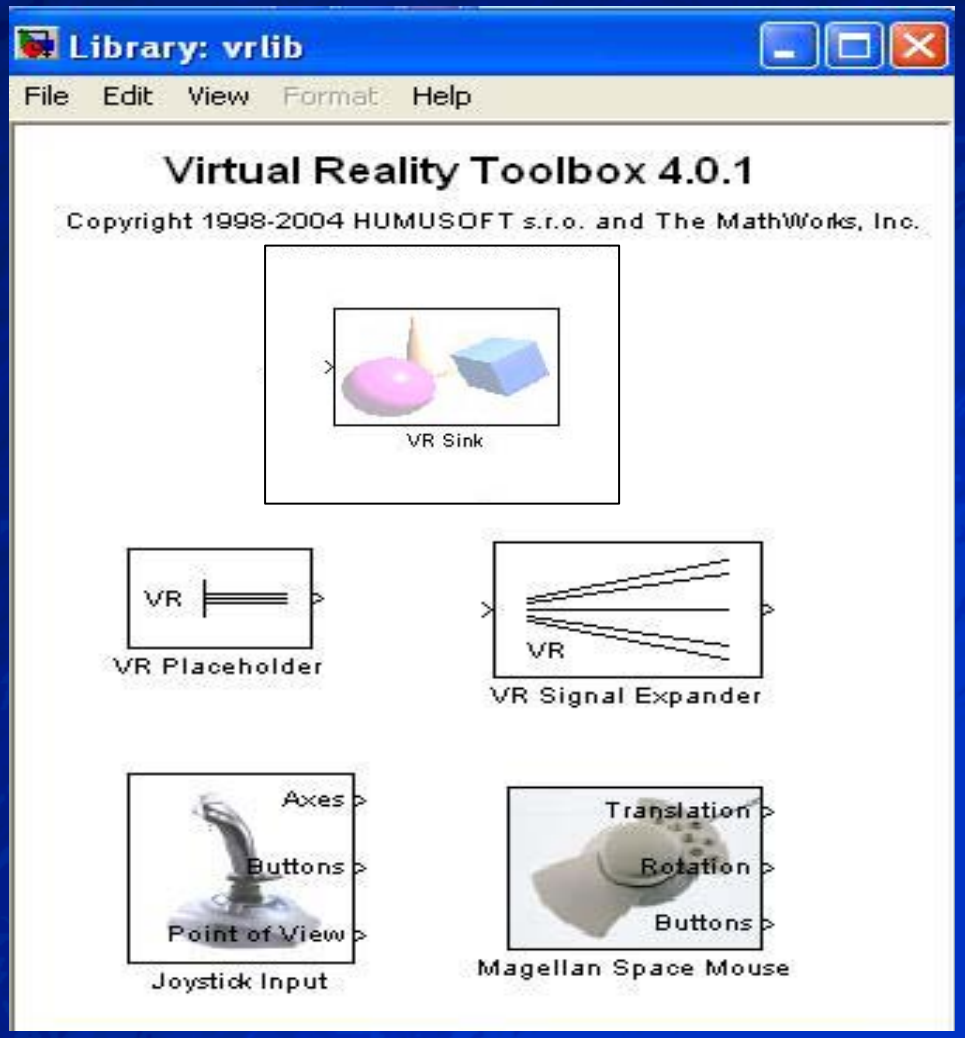


Virtual Reality Toolbox

Solid Edge

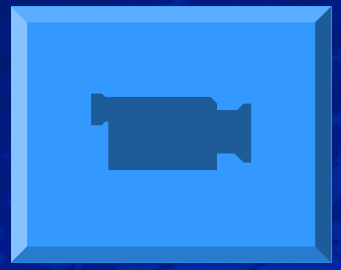
VRealm Builder

VR toolbox

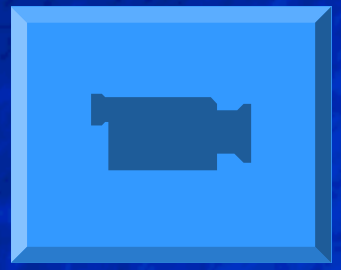


Animation in VR

Straight path



Non-linear path



Solution

- To measure the comfort level of the buggy
- Shows displacement in various directions
- Determine the appropriate spring and damper coefficients of the suspension system

Conclusion

- Virtual prototype of buggy from 2D plans created
- Evaluate performance of buggy
- Further developments

We don't just want to build buggies...
we want to build dreams!

- Badland Buggy

References

Badland Buggy 2D Off-Road Vehicle Plans & Quality Parts, ST2. (2003) Calgary, Alberta, Canada.

Barr, A. J., & Ray, J. L. (1996). Control of an active suspension using fuzzy logic. International Conference on Fuzzy Systems, v 1, p 42-48.

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