Matlab Modelling At Sydac

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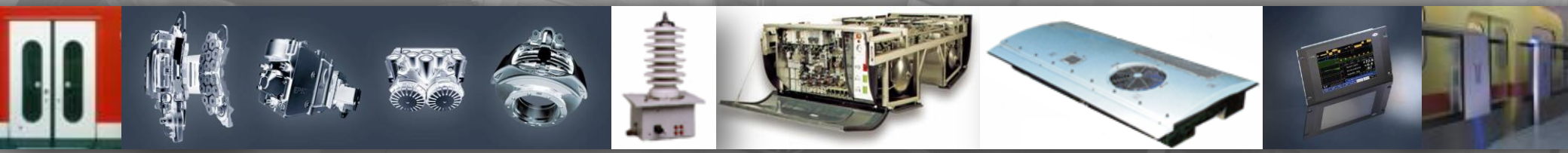
Corporate Overview (Knorr-Bremse)

Founded	1905
Experience	100 years of Innovation
Independence	Family owned
Employees	18.143*
Sales	4,2 Mrd. EUR*
R&D expenses	4,9 % of turnover*
Investments	159 Mio. EUR**



Corporate Overview (Knorr-Bremse)

SYDAC

MathWorks®

NEW YORK AIR BRAKE | merak | SIGMA | SYDAC | iFE Innovations For Entrance Systems | RAILSERVICES | PowerTech

ZELISKO | WESTINGHOUSE platform screen doors | Microelettrica Scientifica | Bendix | HASSE & WREDE | Bendix Spicer Foundation Brake LLC A Bendix CVS and Dana Joint Venture | active service

Corporate Overview - Sydac

Origins

- Headquarters in Australia, with worldwide offices
- Supporting the rail/road industry since **1995**
- **One of the largest** rail/road simulator supplier

Markets

- Core business in **rail/road transport simulation**
- **Over 150 employees** working on simulation
- Expertise in **passenger & freight rail simulation**

Products

- **Simulator systems**, e.g. full cab, console..
- Knowledge and situation based **eLearning tools**
- **System maintenance** and **upgrades**

Corporate Overview

Light Rail

- Yarra Trams (biggest LRV network in the world)
- VB Karlsruhe (1st Tram-Train network in the world)
- SND Tram Co

Metro/Commuter

- London Underground (prime supplier with 9 simulators)
- Shanghai Metro (biggest metro network in the world)
- RailCorp

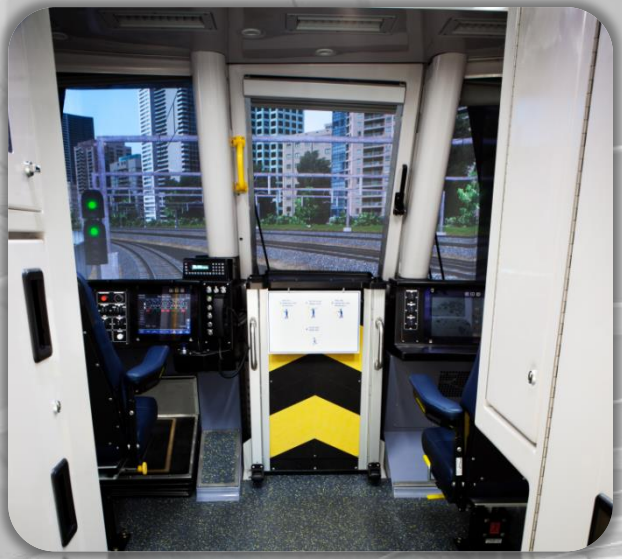
Operation Control Centre

- Jernbaneverket (combined operation of train driving & signalling simulators)

Freight

- Rio Tinto (including LEADER®)

Simulator Types



Driver Cab

- High fidelity immersive training environment
- Practise/Development of **psychomotor skills**
- Driving skills demonstrated more **fairly** & **realistically**

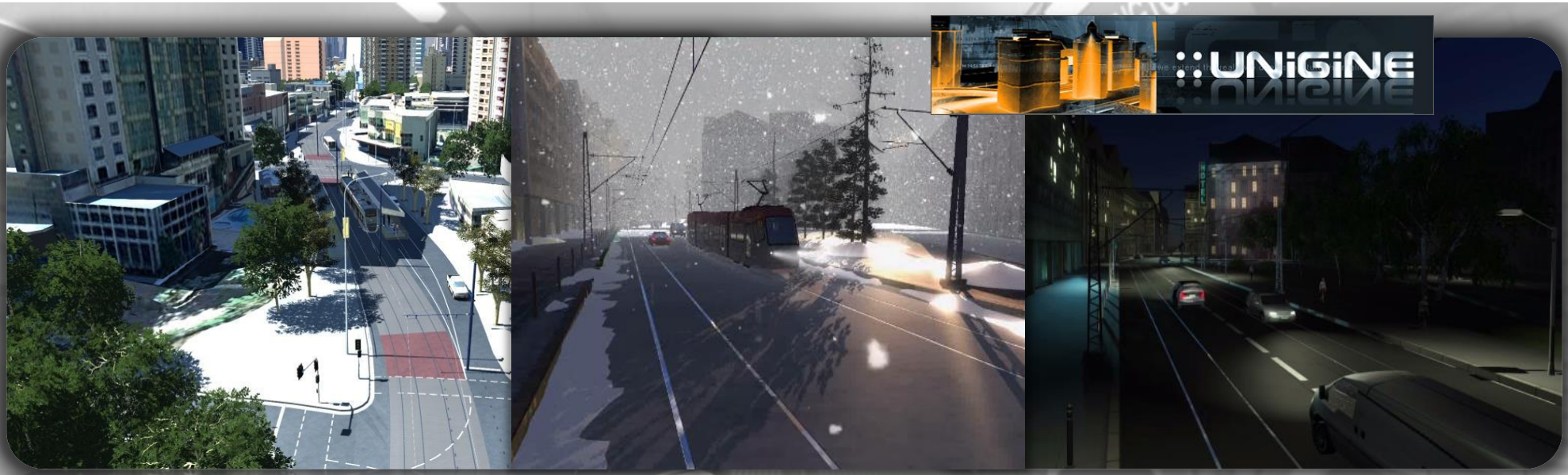
Driver Desk

- High fidelity driver controls at lower procurement costs
- **Smaller footprint** & **easily transportable** (flight case)
- Allows group of trainees to interact simultaneously

Driver Console

- Associated with medium to low fidelity devices
- Used to **increase training throughput** at low cost
- Can be configured as **multi-purposes**

Vision System



Computer Generated Imagery

"The **quality of the Computer Generated Images** as seen by the trainee driver is **one of the key criteria to their successful engagement in the training process** and has a **significant impact on their ability to learn from the training experience**."

- Leading provider of simulation and 3D visualisation technologies
- Highly realistic and dynamic simulation environment (AAA vision processing engine)
- Advanced HDR rendering & special effects (volumetric light, shadow and cloud effects..)

Vision System

Motion Sensing Vision

Generates a virtual window matching the real window, using **non-intrusive tracking device** (Microsoft Kinect motion sensing camera) to identify the trainee's viewing point

Benefits

- Improved perception of 3D visualisation
- Unbounded Field Of View
- High Brightness and depth perception

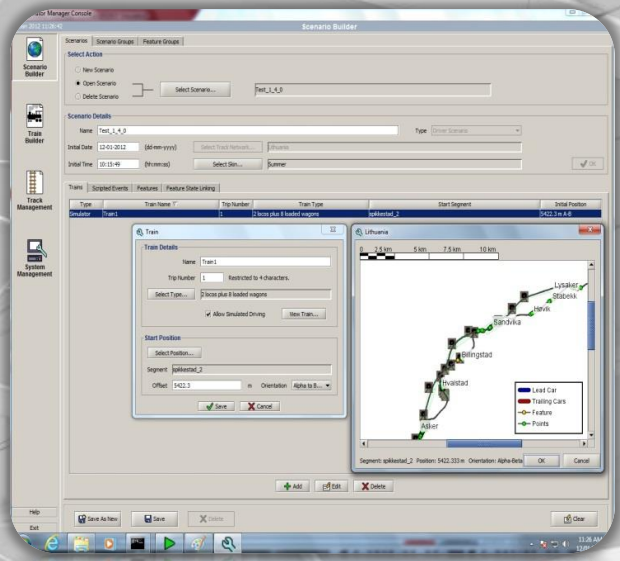
Software Features

Session Evaluation

- Configurable competence assessment tools
  - Video surveillance
  - Automatic scoring
  - End of run report
  - Full replay

Scenery Control

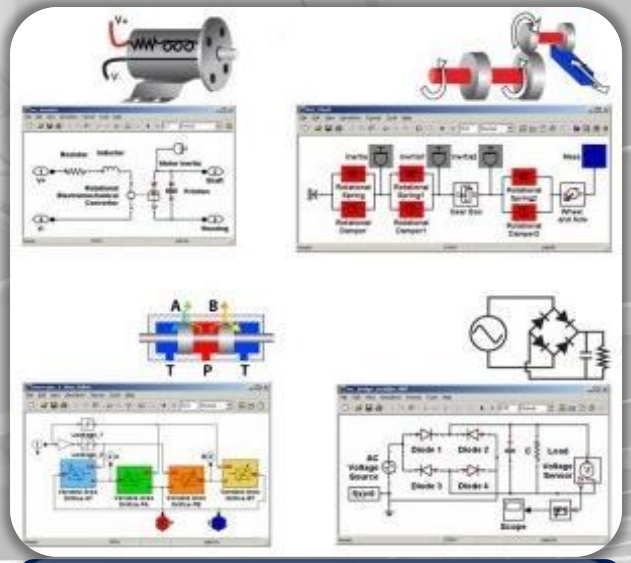
- Graphic interface based on 3D view of the virtual world
- Integrated with Artificial Intelligence, avatar control, traffic management, sound control..



Session Control

- Windows based point & click graphic interfaces
- Create & edit training programs
- Run, control, save & replay simulation sessions

Software Features



Vehicle Model

- Models shown to be over **99% accurate** to OTR data
- **White-box 1:1 modelling** of vehicle & infrastructure
- Built using the **OEM schematics, data**..

Assets

3D models (**Rocketbox Studio**) of pedestrians, passengers, road vehicles, civil engineering assets, animals, rail/road workers, objects..

World Model

Allow customers to create & edit their own world/track **independently of the simulator supplier**

COTS Software

SYDAC

MathWorks®

MATLAB®
SIMULINK®

Vehicle Model

Rocketbox Libraries

WORLDMACHINE

AUTODESK. 3DS MAX

UNIGINE

esri CITYENGINE

World Model

eclipse

ORACLE®

Visual Studio

Microsoft

Core Platform

- **Avoidance of proprietary software technology**
- Recognised **industry standard software development tools**
- Core simulation platform developed using high-level programming languages

Benefits

- Ongoing support without the risk of obsolescence
- Customer is free to maintain and further develop the simulator

COTS Hardware

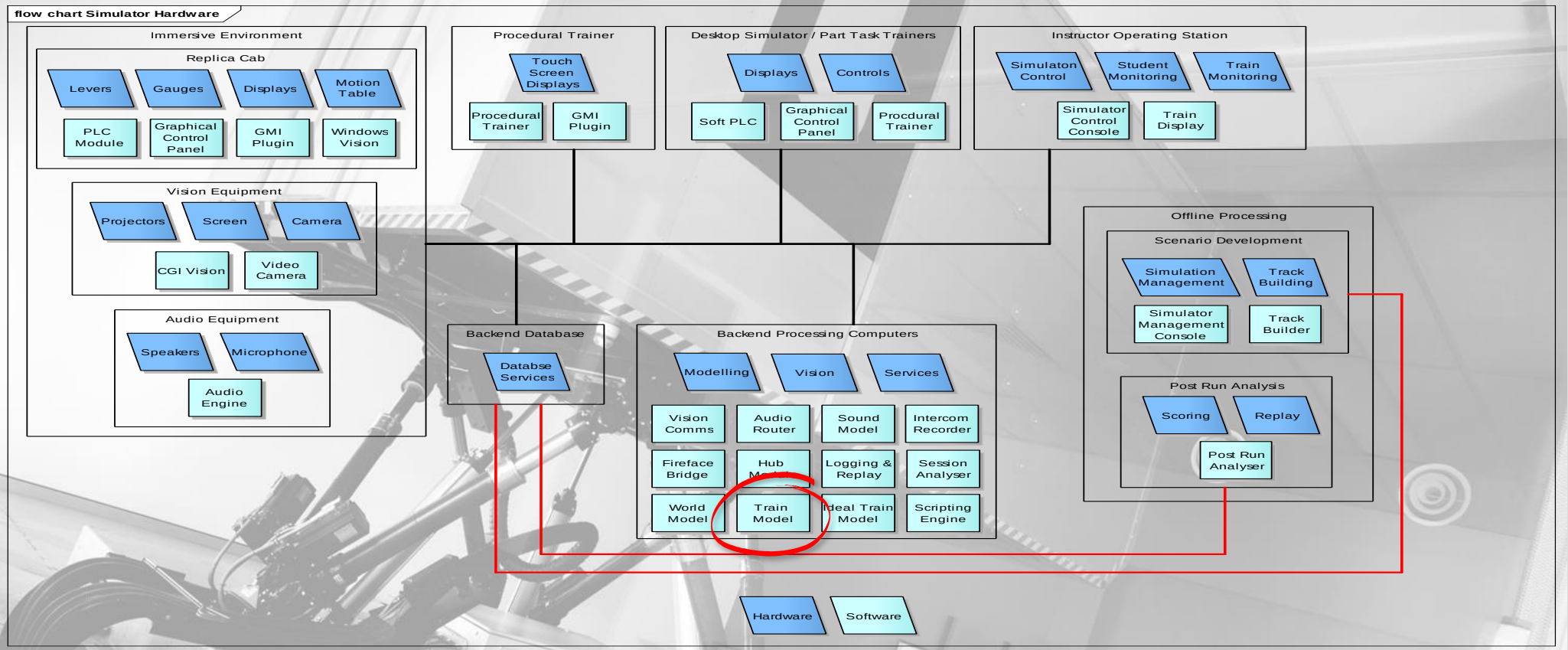
Modular Computer Architecture on Ethernet Network

- **Avoidance of proprietary hardware technology**
- Distributed, modular and expandable **IO modules** interfaced via a 100Mb/s Ethernet network
- SuperMicro **Intel®** Core i7 PCs, **NVIDIA** graphic cards, **Logitech** sound system, **Samsung** LCDs..

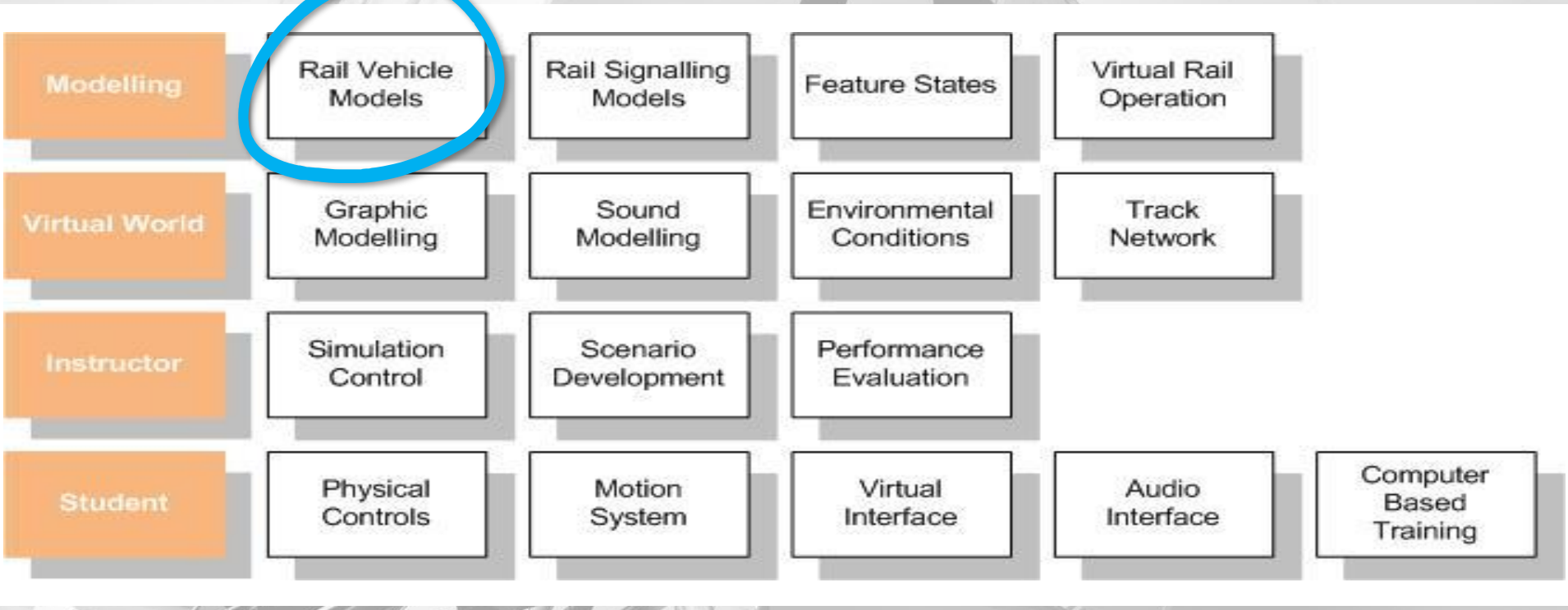
Benefits

- Ongoing support without the risk of obsolescence
- Customer is free to maintain and further develop the simulator

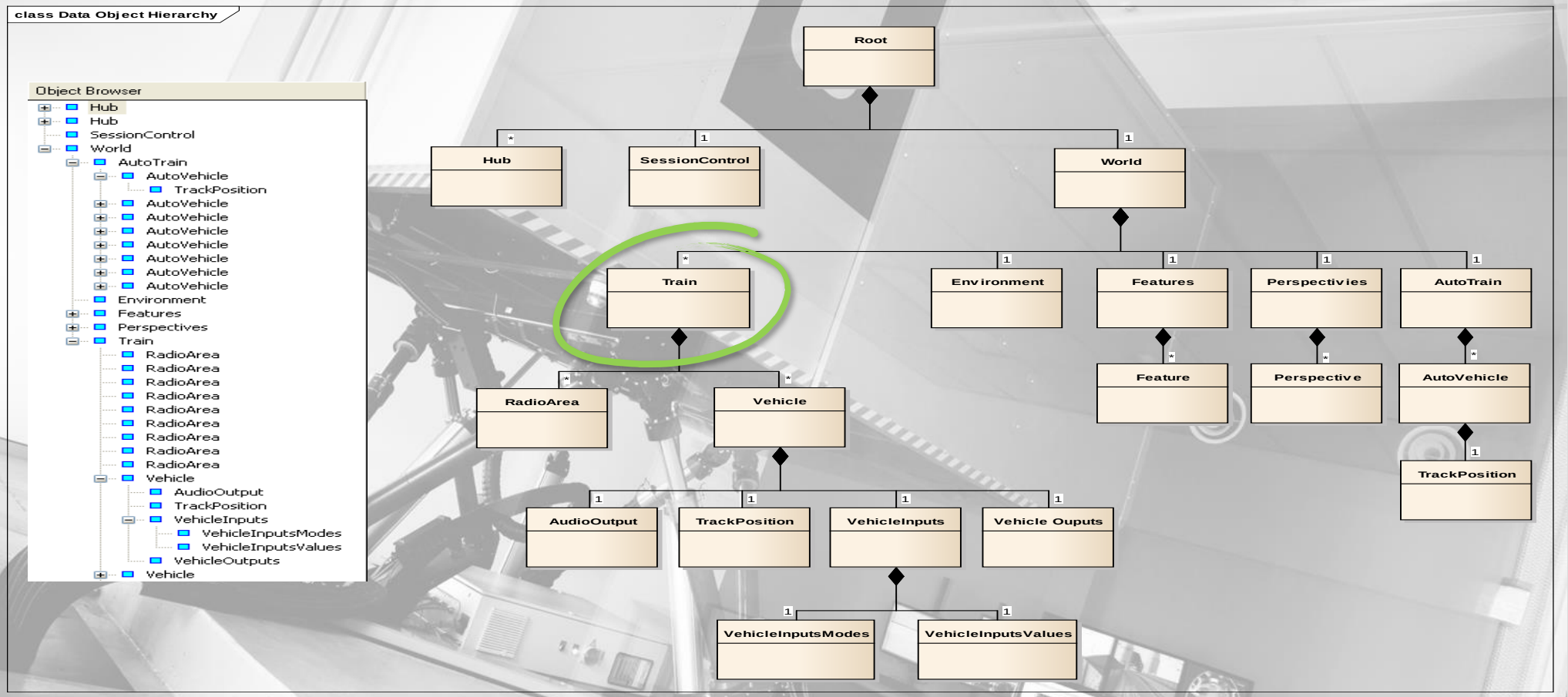
Anatomy of a Train Simulator



Anatomy of a Train Simulator

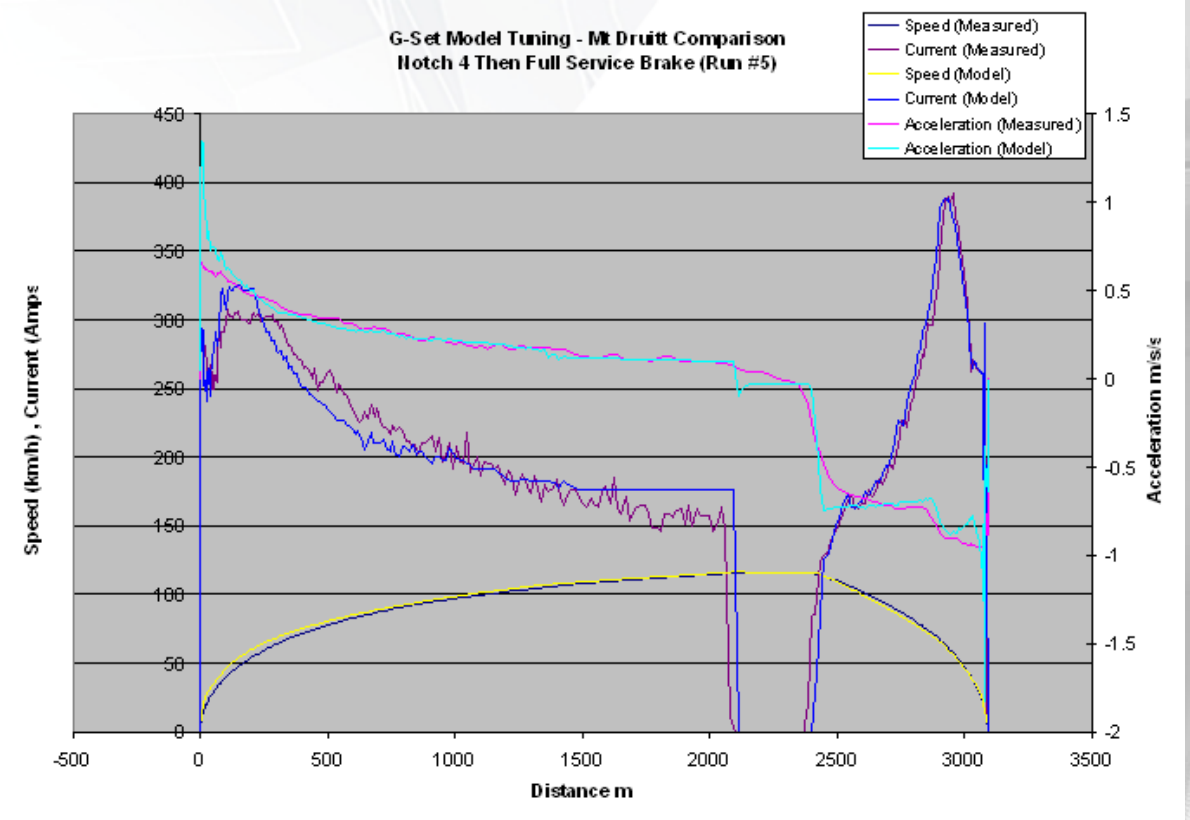


Anatomy of a Train Simulator

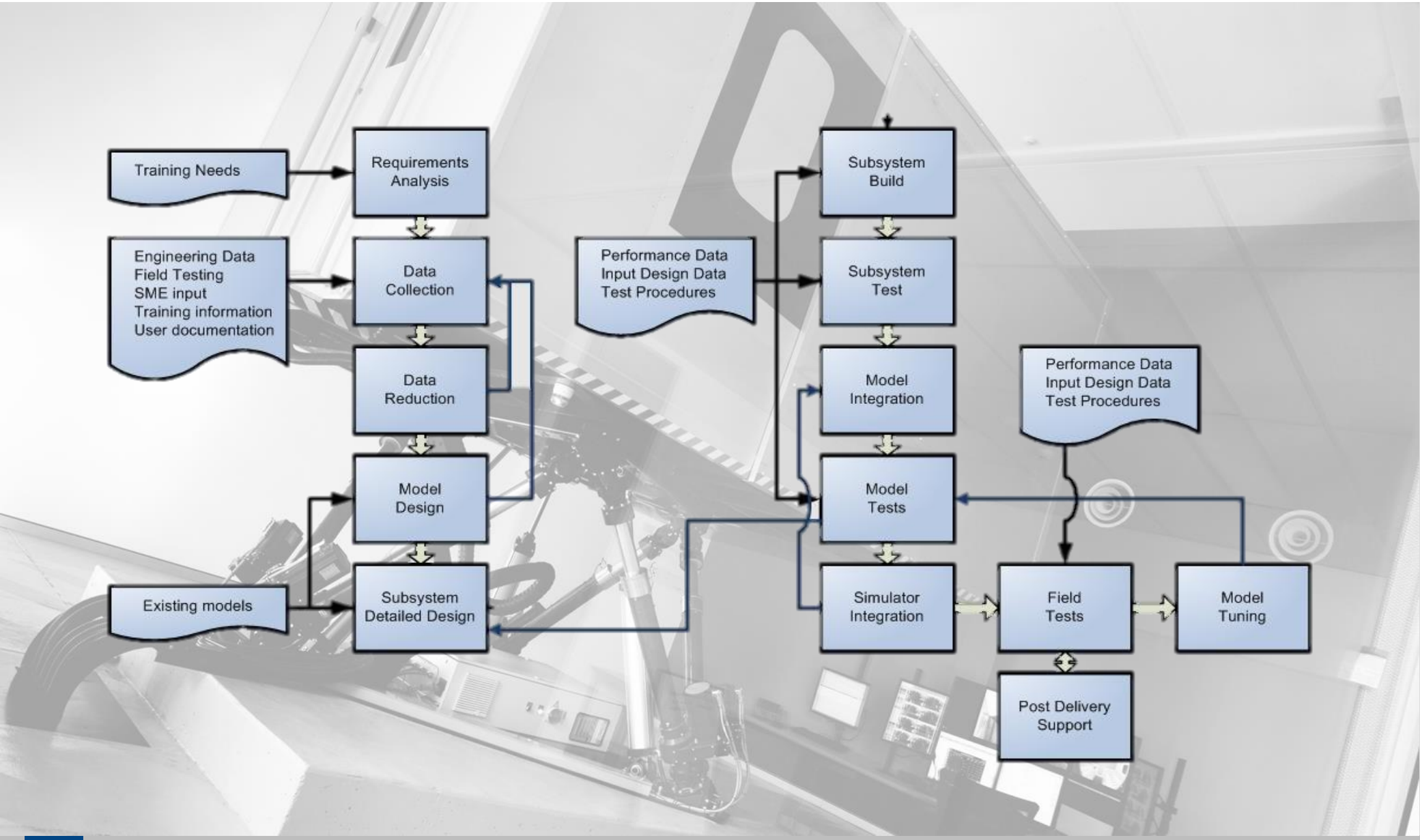


Train Model

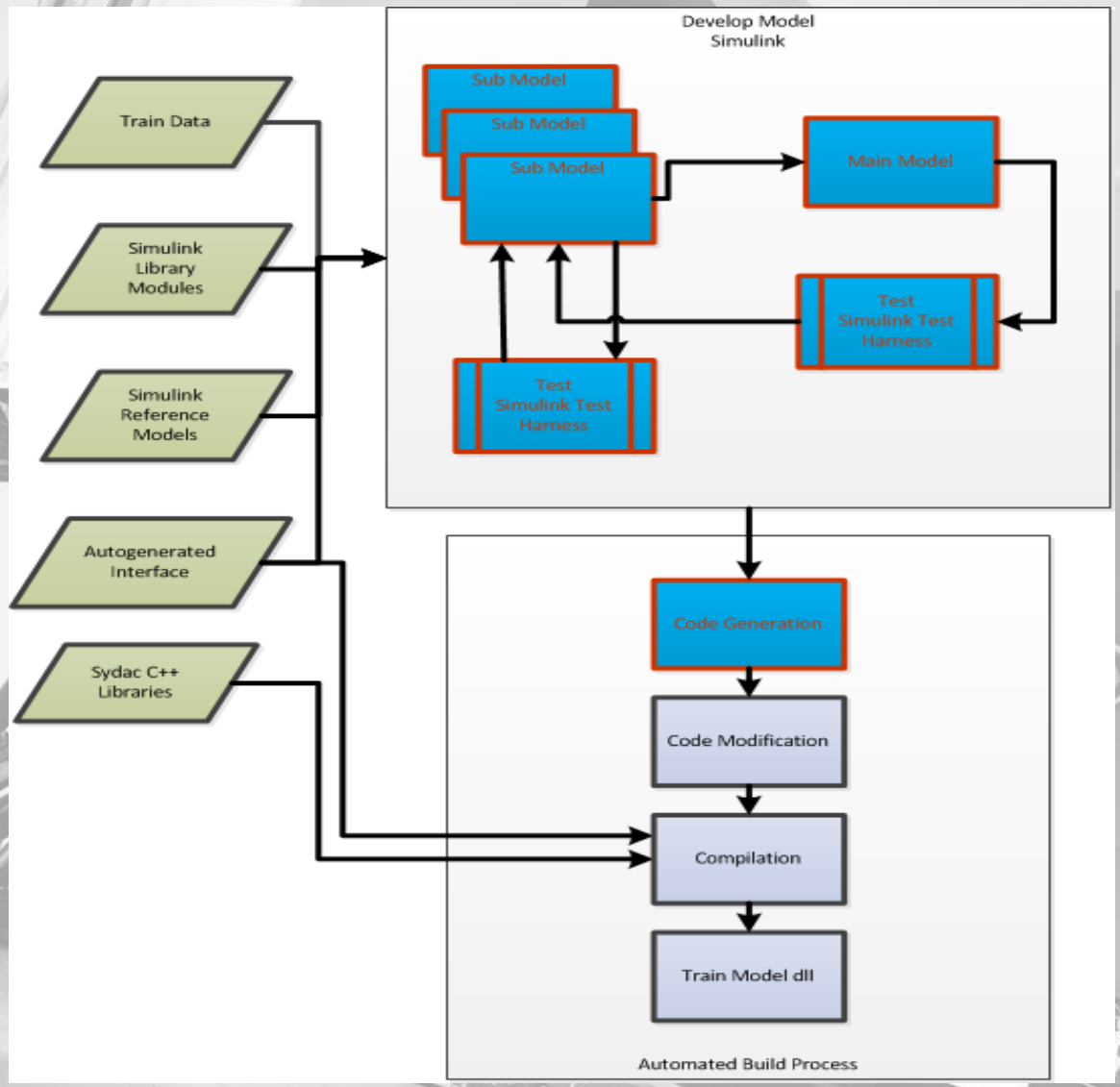
- **Dynamic Model**
  - Coupling
  - Rolling resistance
  - Gravitational forces
  - Rail adhesion forces
  - Braking and tractive forces
- **Brake system model**
  - Brake controller
  - Brake piping system
  - Trailer car brake system
- **Traction system model**
- **Train Control & Management System model**
- **Suspension model**



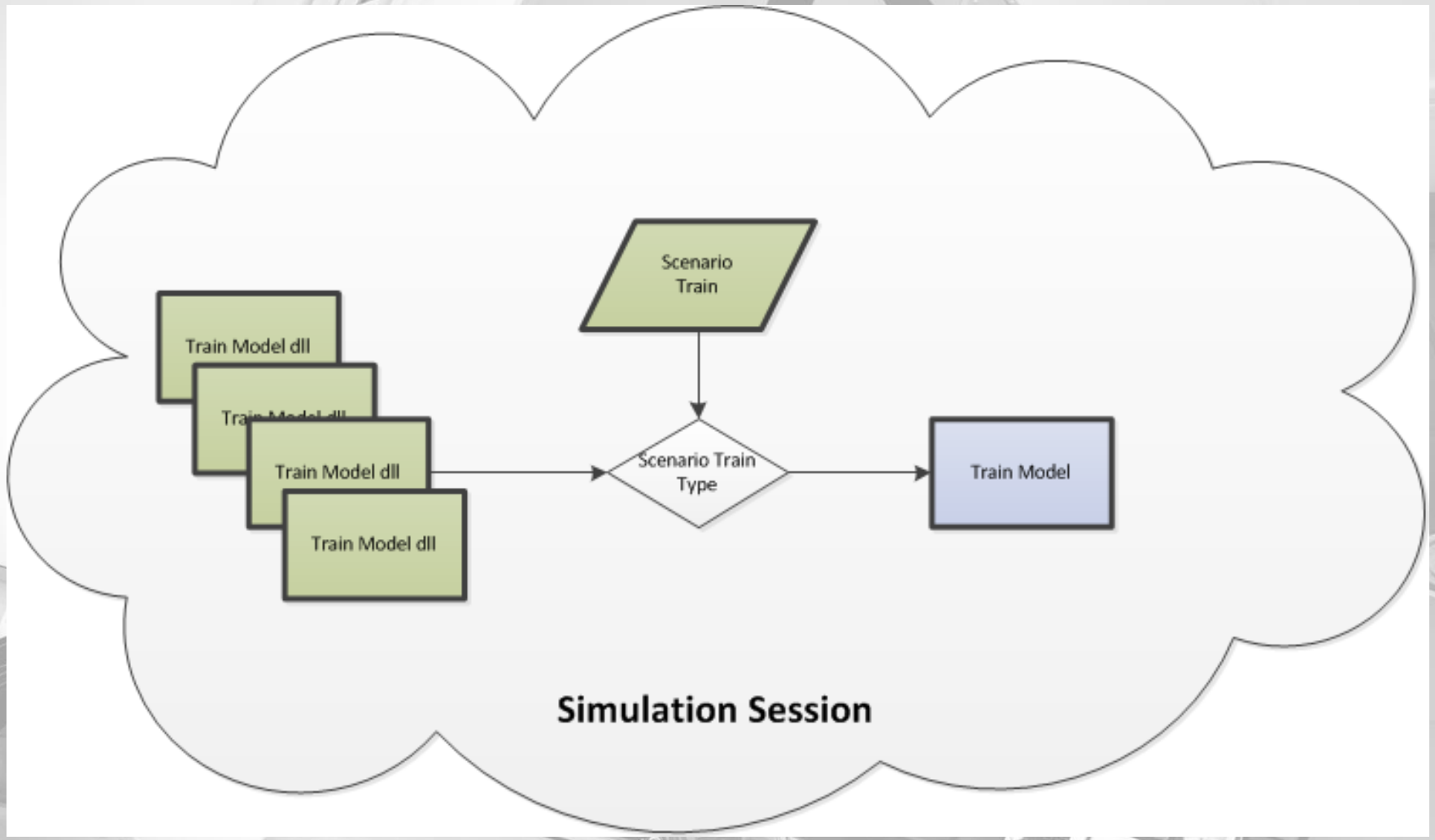
Train Model Development Process



Matlab Integration

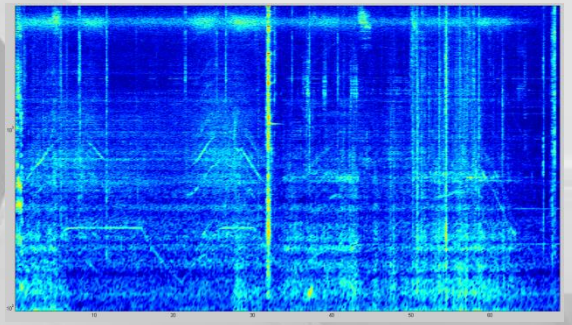


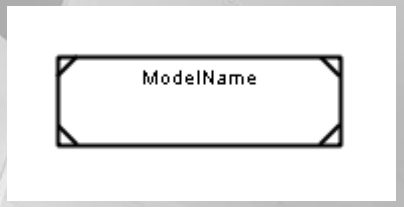
Train Model Simulation

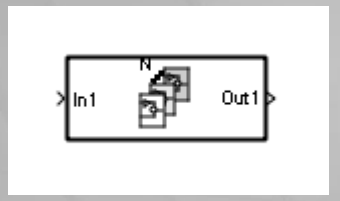


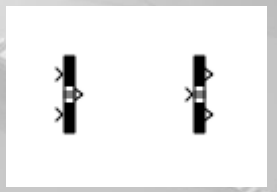
Key Matlab Components

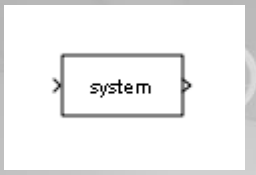
- Matlab
  - Mathscript
  - Data Reduction
  - Data Visualisation
- Simulink
  - Subsystems
  - Reference Models
  - Libraries
  - For Each Subsystems
  - Bus and Vector of Busses
  - S-Functions
- Simulink Project
- Matlab / Simulink Coder
  - CAPI
- Stateflow

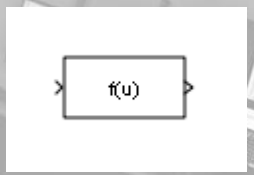


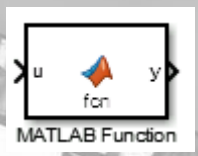




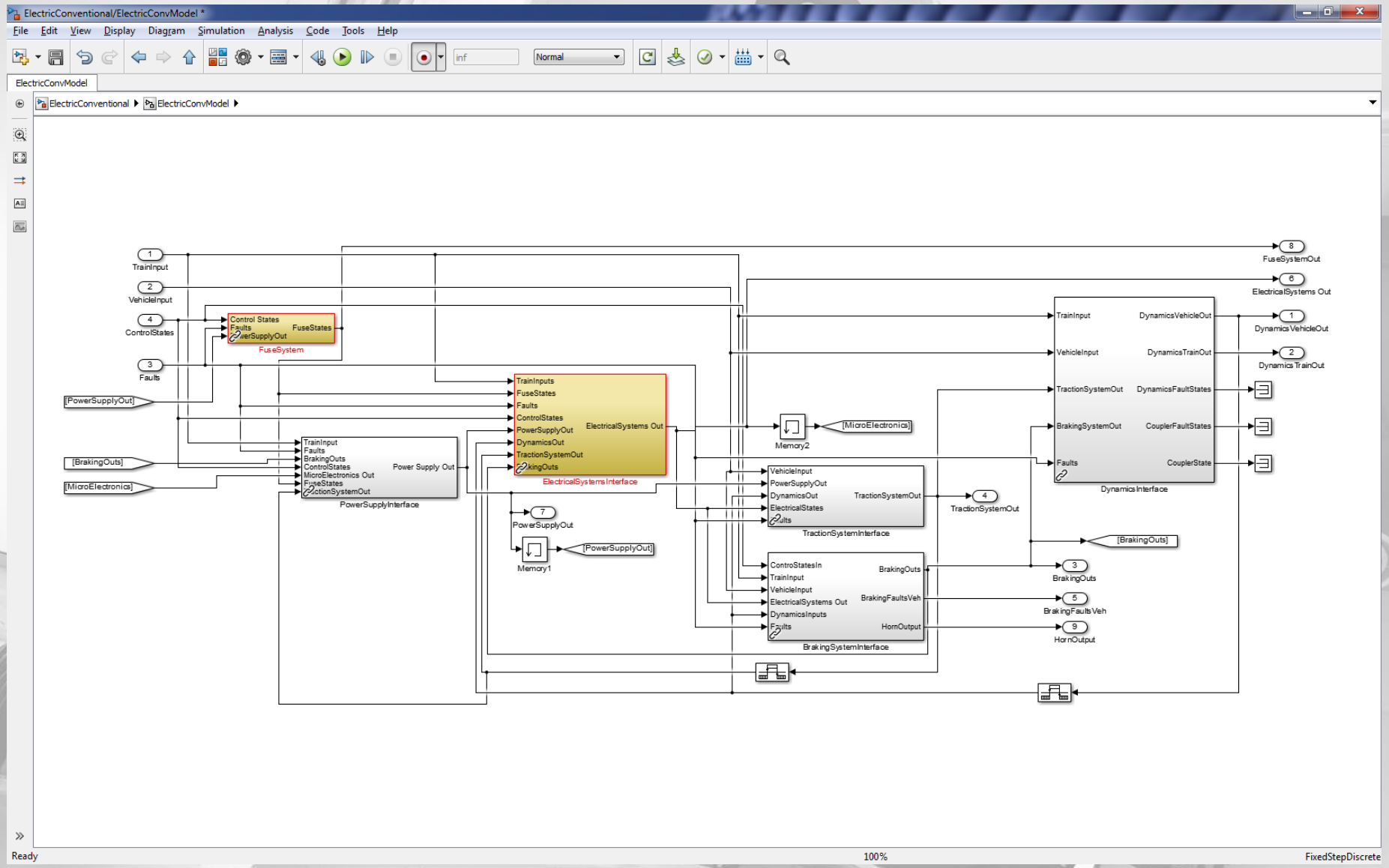




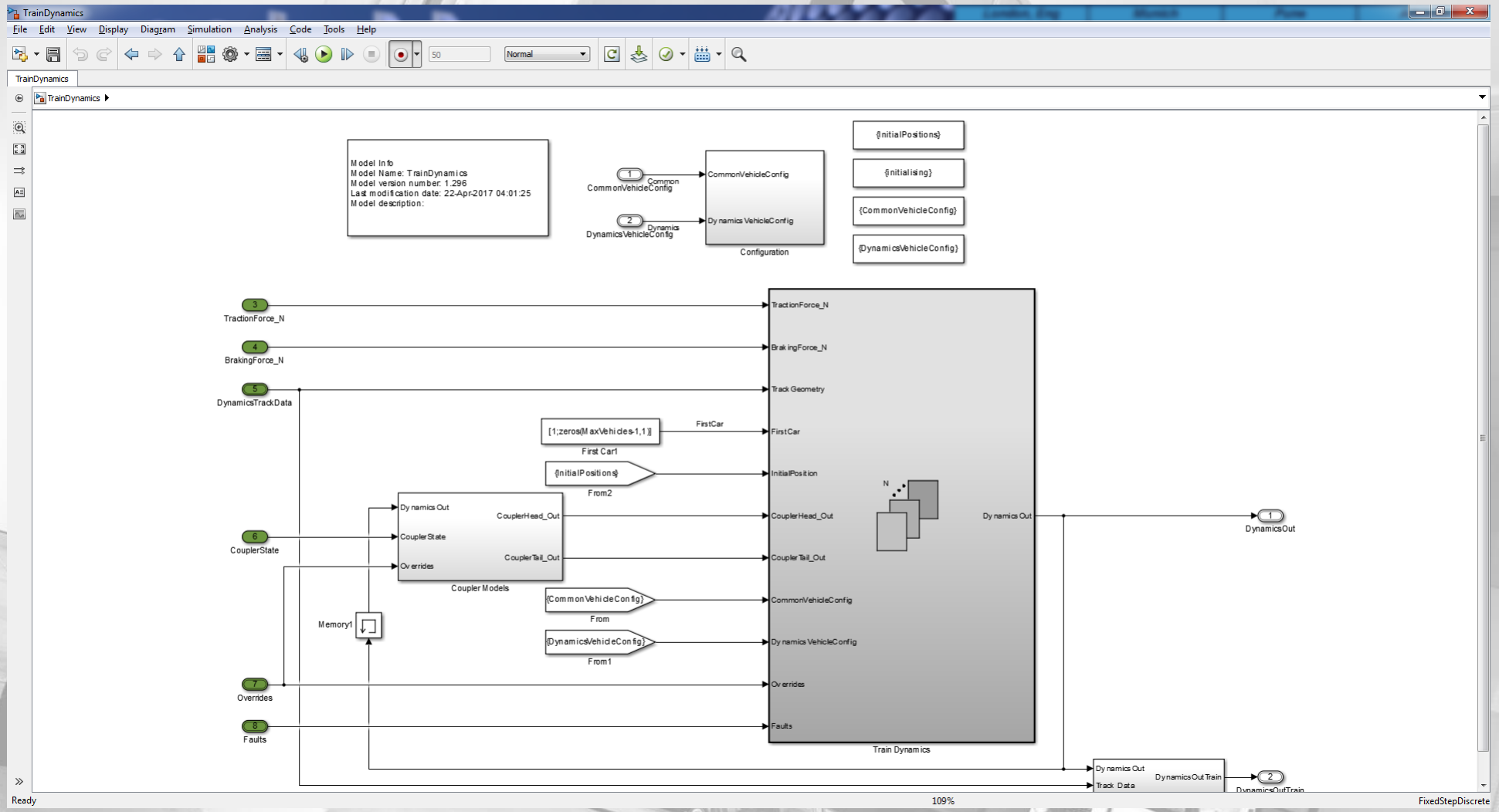




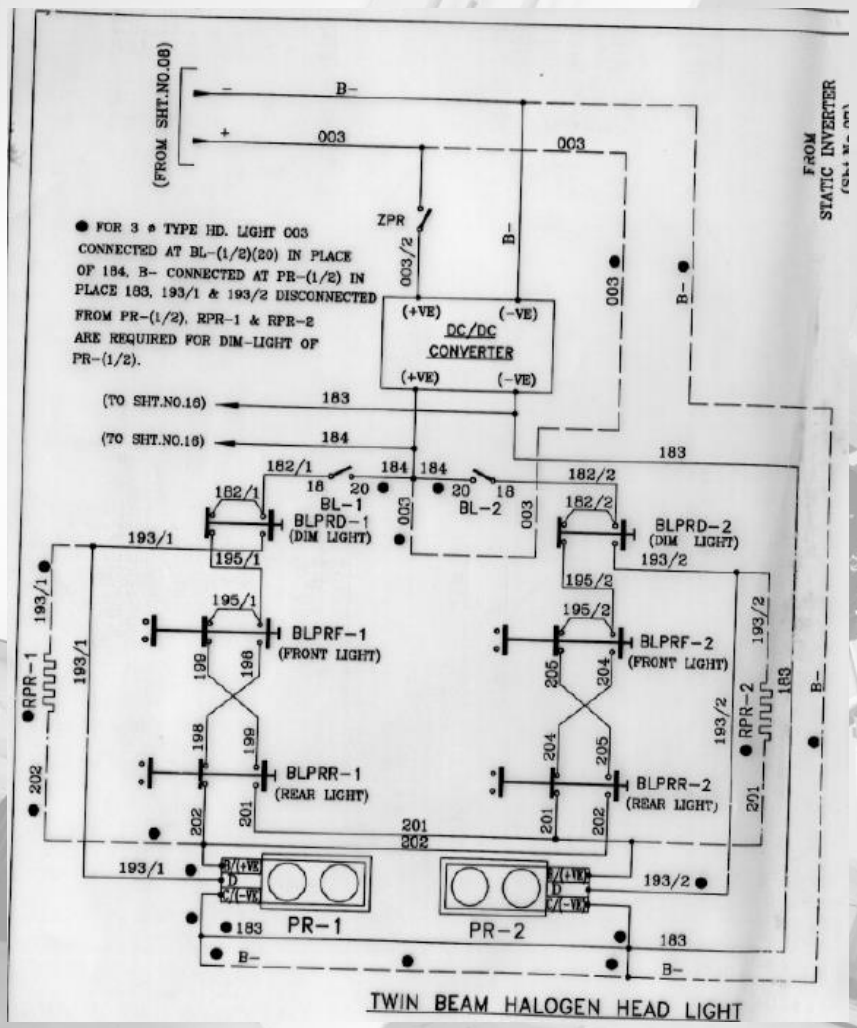
Model Examples – Top Level

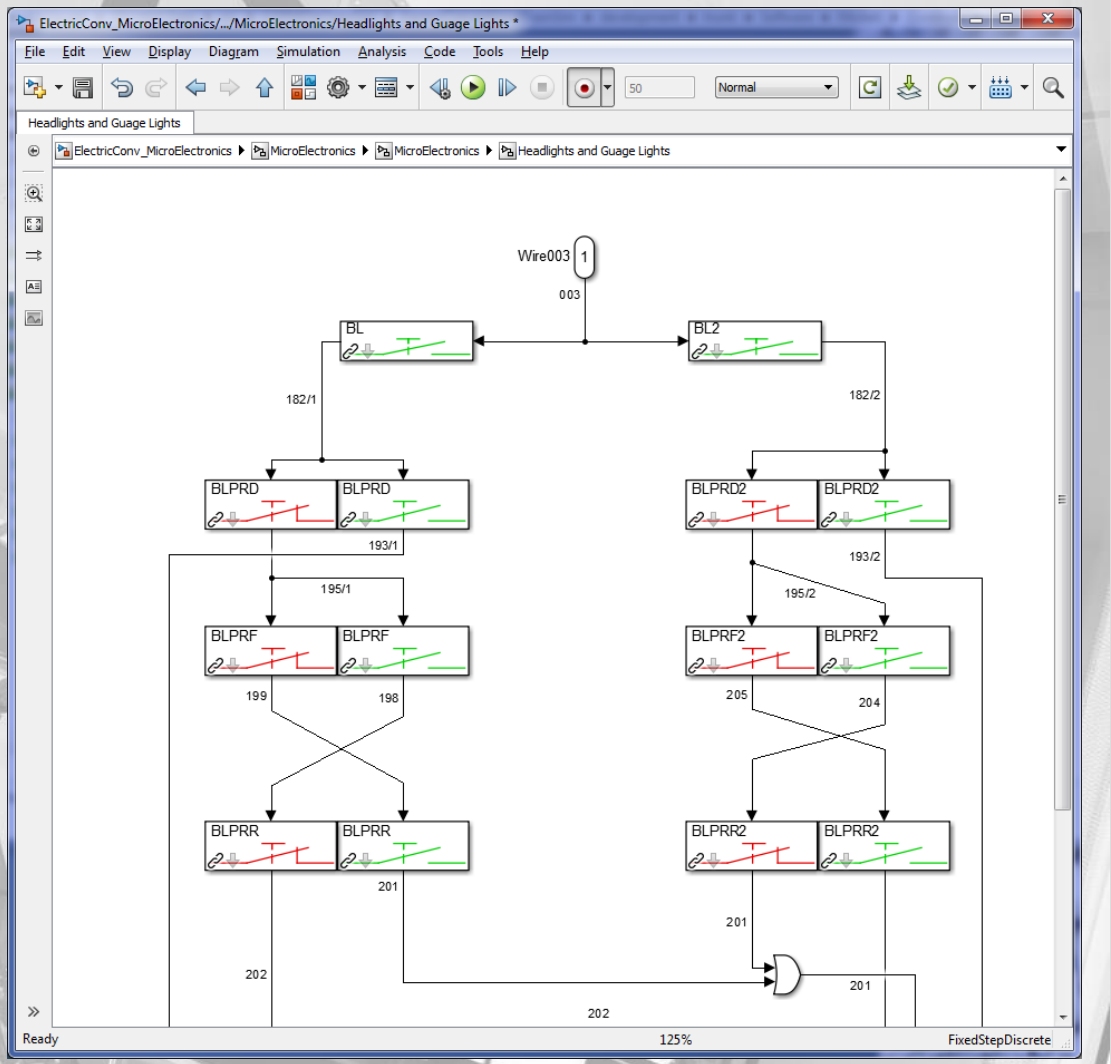


Model Examples - Dynamics

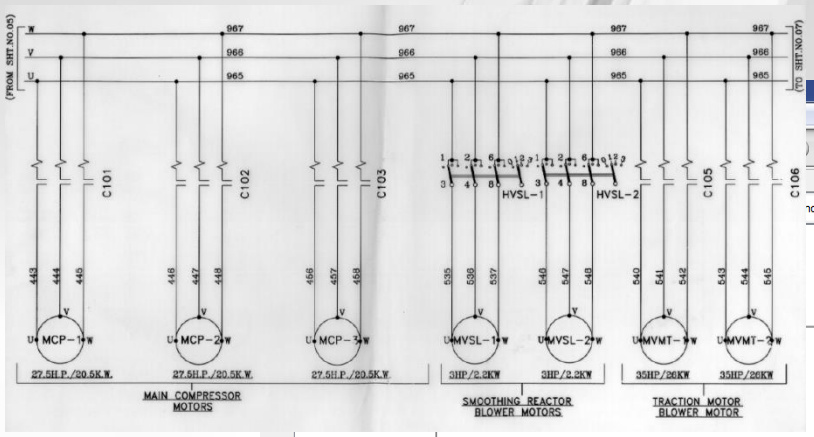


Model Examples - Headlights

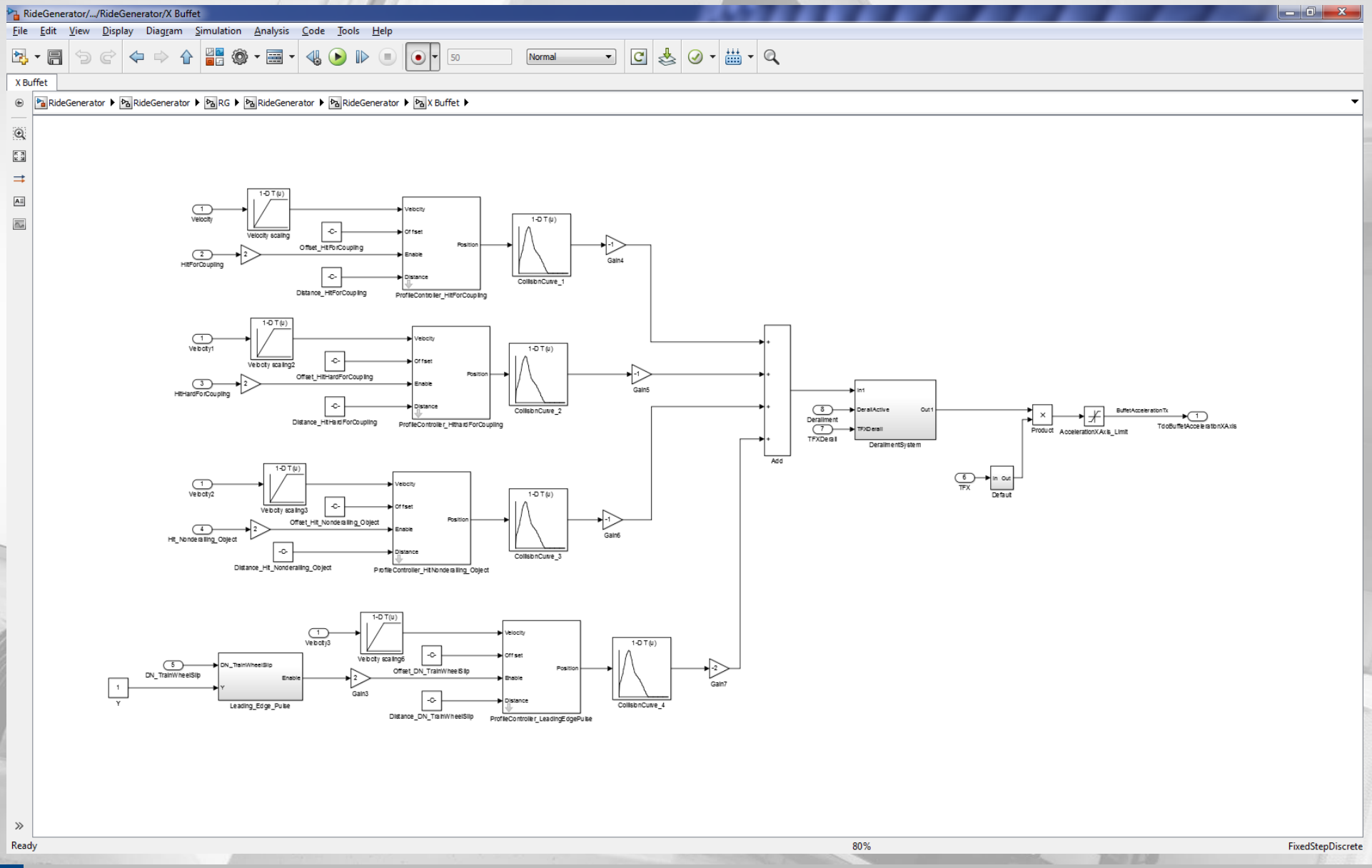




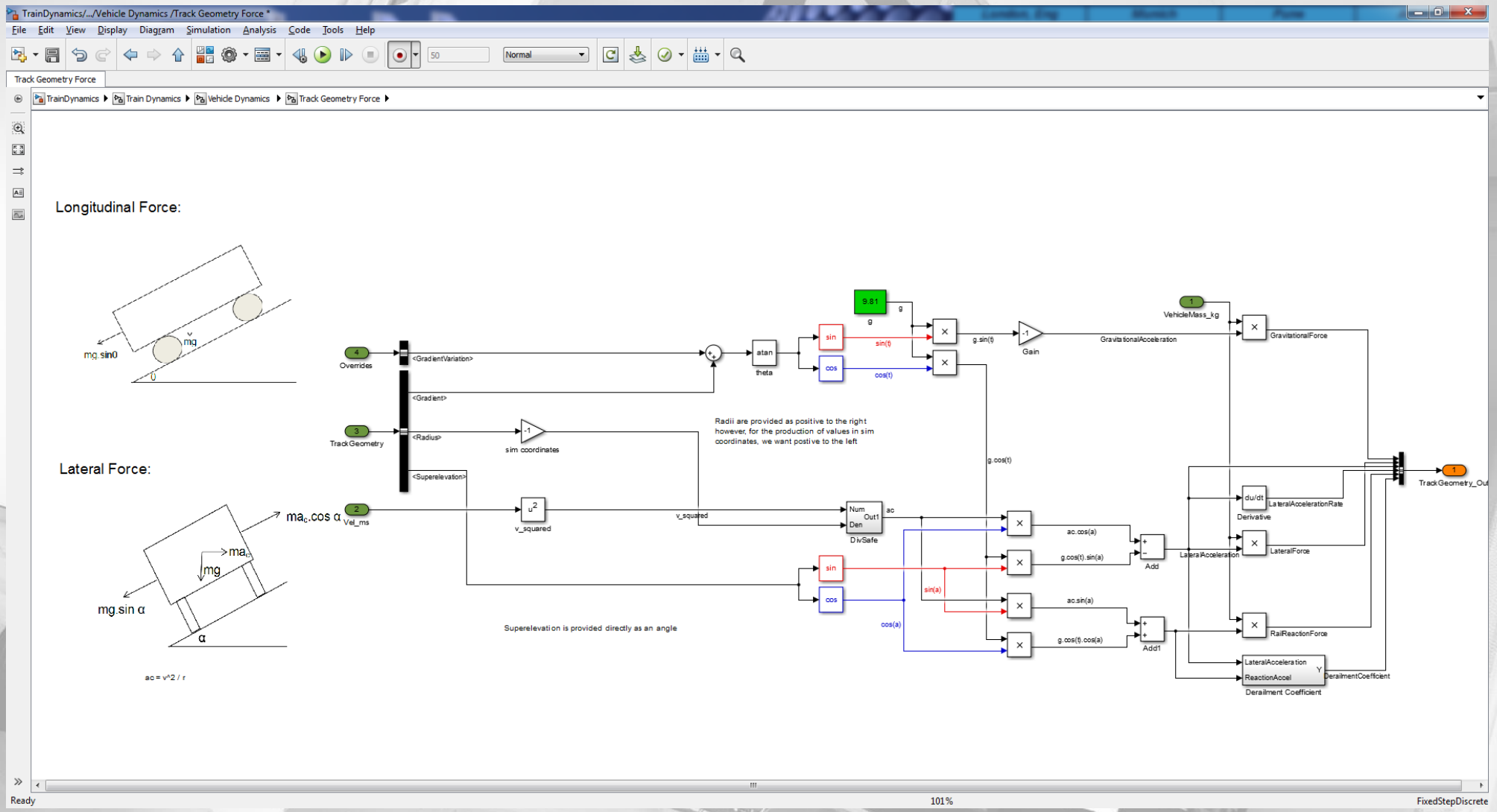
Model Examples – Motor Control



Model Examples – Ride Generator

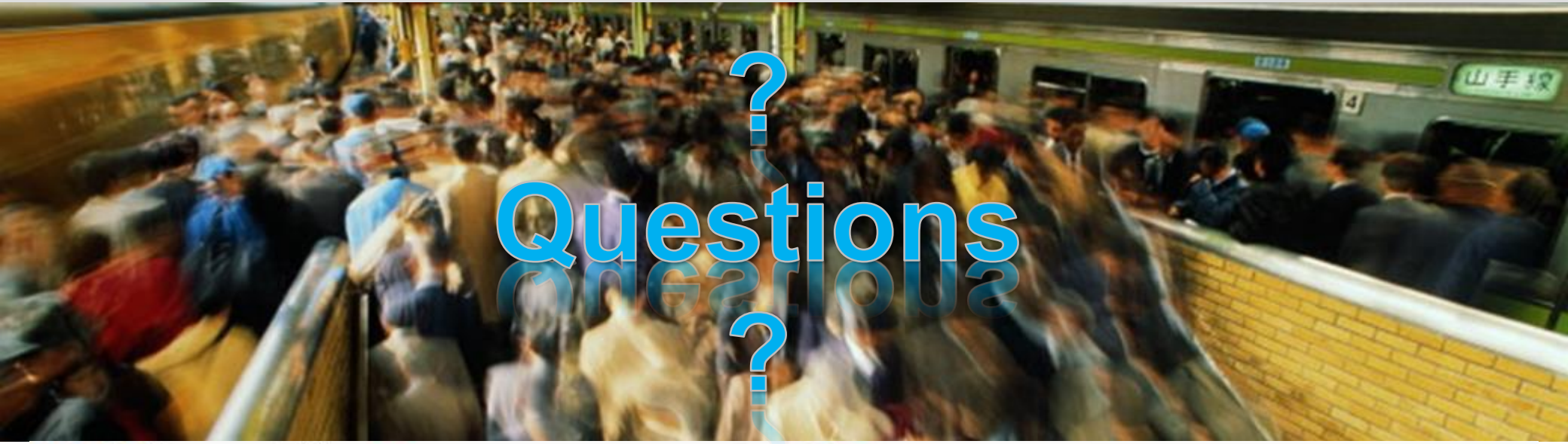


Model Examples – Track Geometry



Matlab Key Benefits

- Graphical modeling environment – modelers do not need to be programmers
- Code-Generation – automated model deployment
- Rich tool set
- Mature user interface
- Simulation and debugging environment
- Large user base – resource availability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Questions
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