Matlab Modelling At Sydac
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*Knorr-Bremse Group*
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
“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..)
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**

**Vehicle Model**

**World Model**

**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
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

1. Training Needs
2. Requirements Analysis
3. Data Collection
4. Data Reduction
5. Model Design
6. Subsystem Detailed Design
7. Existing models
8. Subsystem Build
9. Subsystem Test
10. Model Integration
11. Model Tests
12. Simulator Integration
13. Field Tests
14. Model Tuning
15. Post Delivery Support
16. Performance Data Input Design Data Test Procedures
Matlab Integration

Develop Model Simulink

Train Data
Simulink Library Modules
Simulink Reference Models
Autogenerated Interface
Sydac C++ Libraries

Sub Model
Sub Model
Sub Model
Main Model
Test Simulink Test Harness

Test Simulink Test Harness

Code Generation
Code Modification
Compilation
Train Model dll

Automated Build Process
Train Model Simulation

Simulation Session
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 - Dynamics
Model Examples - Headlights
Model Examples – Motor Control
Model Examples – Ride Generator
Model Examples – Track Geometry

Longitudinal Force:

Lateral Force:

Superelevation is provided directly as an angle.
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
Questions