PROFESSIONAL DRIVING SIMULATORS TO DESIGN FIRST-TIME RIGHT RACE CARS

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Professional Driving Simulator
Constituents for High Immersion Realism

- Full Cockpit Controls
- Active Seat Belts
- Motion Platform
- Projectors
- Sound Generator (Engine, Tyre, Wind)
- Laser Scan Track Profile
- Graphics Software
- Real Time Vehicle Model

Driver in the Loop!

2014 – 01 – 0099
Professional Driving Simulator
Result: High Immersion Realism

Which one is real?
Professional Driving Simulator
Hardware: Platform, Actuators, Projectors, Sound, Struts

Natural frequency > 40Hz!

180deg FOV QXGA Projectors
Patented 4m OD Platform
Dolby Surround

Max velocity > 2m/s
Max acceleration > 20m/s^2

Patented Carbon 60" Struts
Electro Mechanical Hexapod
Professional Driving Simulator
Software: Vehicle Model – Operating System – Track Data

Open Source Operating System

Laser Scan Track Data

Output: 1000hz Clock!

Open Source Vehicle Model
Too many iterations!

- **Concept**
  - Design
  - Aerodynamics
  - Vehicle dynamics

- **Safety**
  - Driver

- **Track testing**
- **HIL**
Professional Driving Simulator
Case Study: Nippon Super Formula - Sim Approach

All once, at once: Simpler!

Concept
- Design
- Safety
- Track testing
- Aerodynamics
- Vehicle dynamics
- HIL

All once, at once: Simpler!
## Driving Simulator Case Study
### Nippon Super Formula: Early Decision

**Early Decision: Power Steering**  YES / NO ?

<table>
<thead>
<tr>
<th>Mass</th>
<th>575 kg (dry)</th>
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</thead>
<tbody>
<tr>
<td>Engine</td>
<td>I4 turbo 2.0L</td>
</tr>
<tr>
<td>Power</td>
<td>410 kW</td>
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<tr>
<td>Speed</td>
<td>325 km/h</td>
</tr>
</tbody>
</table>

![Car Model](image)

**Graph**

- **Speed**
  - 291 kph
- **Steering Angle**
  - -23.4 deg
  - -18.9 deg
- **Steer Torque**
  - -32.6 Nm
  - -27.6 Nm

**Comparison**

- High assistance / Low steering ratio
- Low assistance / High steering ratio
Driving Simulator Case Study
Nippon Super Formula - Dev Time Saving

Dev Time: 12 weeks vs 26 weeks!!

<table>
<thead>
<tr>
<th></th>
<th>Sim-way [weeks]</th>
<th>Old-way [weeks]</th>
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</thead>
<tbody>
<tr>
<td>Initial Design</td>
<td>Same</td>
<td>Same</td>
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<tr>
<td>Wind Tunnel</td>
<td>3</td>
<td>6</td>
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<tr>
<td>Prototype Build</td>
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<td>6</td>
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<tr>
<td>Poster Rig</td>
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<td>2</td>
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<tr>
<td>Prototype Track Test</td>
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<td>4</td>
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<tr>
<td>Design Review</td>
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<td>6</td>
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<tr>
<td>Final Track Testing</td>
<td>--</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Dev Time</strong></td>
<td><strong>12</strong></td>
<td><strong>26</strong></td>
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</tbody>
</table>
The Simulator **digests all components** and...

... the car is right off the box: no Magic!!
Protagoras: "Man is the measure of all things"

Questions?

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Driving Simulator Manager