Rail Technology Unit

4TH ADAMS/RAIL USERS' CONFERENCE

1999

UTRECHT, THE NETHERLANDS

APRIL 28TH - 29TH 1999

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Rail Technology Unit

Introduction to the
Rail Technology Unit
at
Manchester Metropolitan University

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Introduction

Areas of Expertise

- Computer simulation of vehicle dynamic behaviour.
- Component testing
- Rolling railway test rig
- Expert services resourcing and project co-ordination.
- Leading edge research.
- Software benchmarking.

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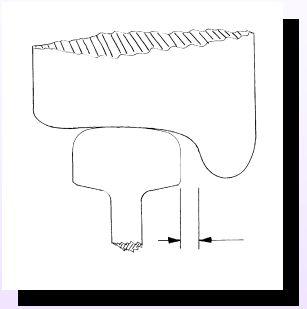
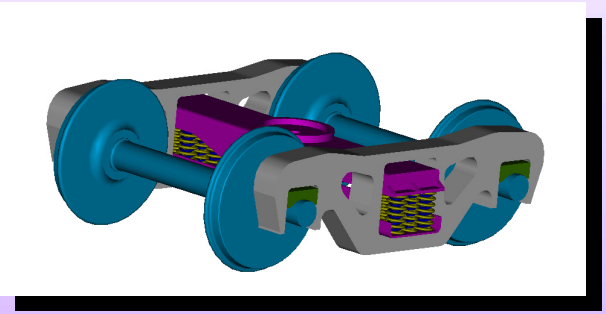
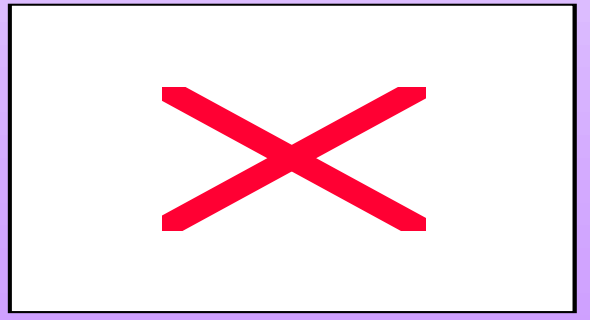
Dynamic Modelling



Expertise in:

- Evaluating vehicle-track interaction.
- Studying track and substructure degradation.
- Assisting with vehicle design / optimisation
- Problem solving on existing fleet.
- Derailment analysis.





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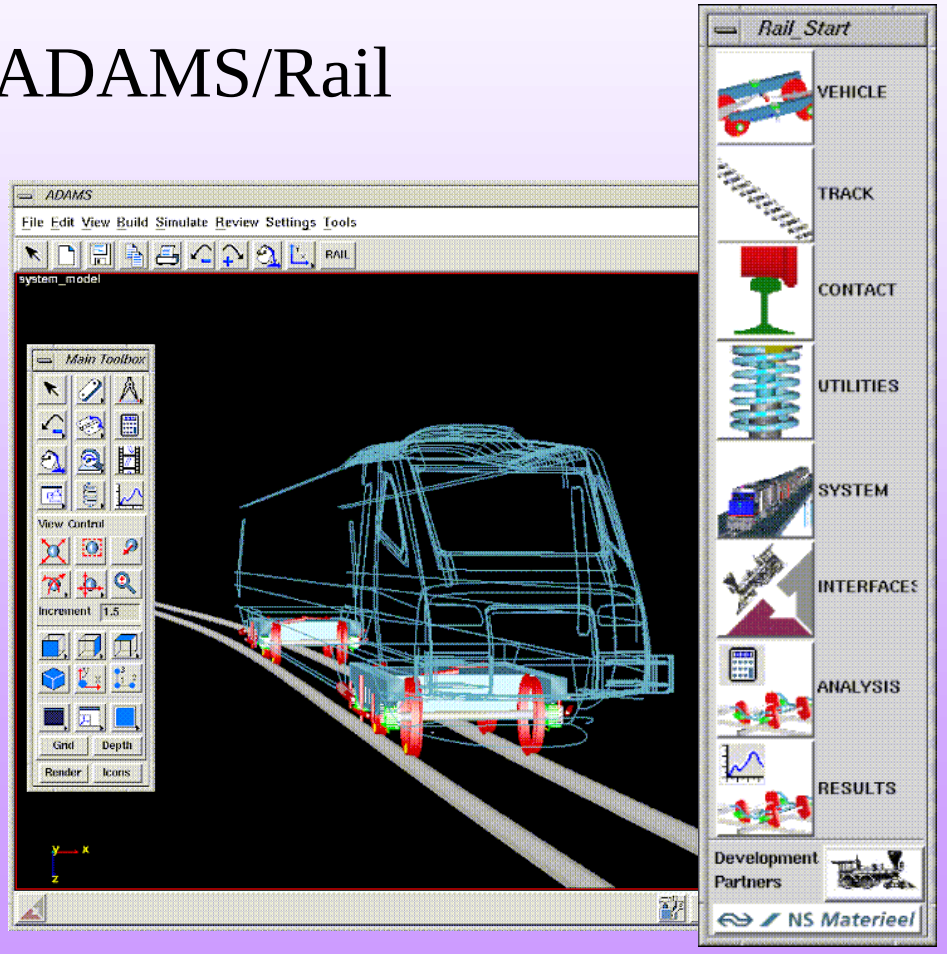
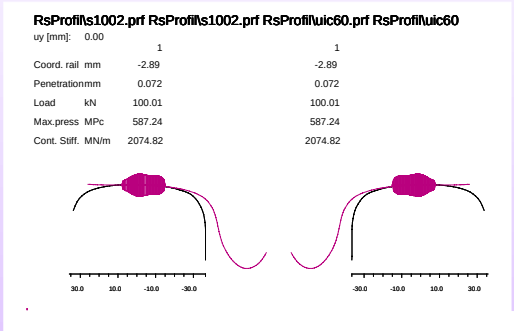
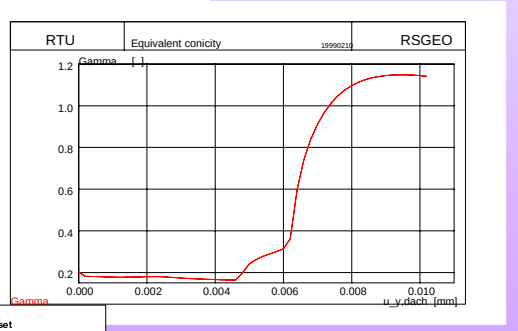
Computer Modelling

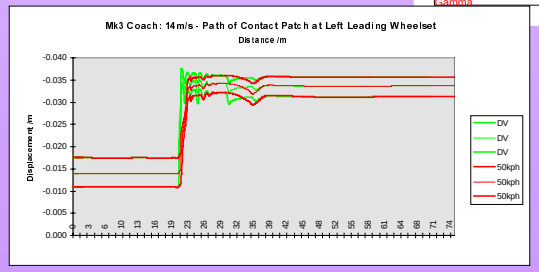
ADAMS/Rail



MEDYNA







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Rolling Railway Test Rig

- 1/5th scale rolling railway test rig for study of lateral dynamics.
- Scale speeds up to 400km/h
- Rollers excited using digital controllers & hydraulic actuators to simulate track inputs.
- Can be fully instrumented to measure bogie response.
- Applications include studying novel components or bogie designs.

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Component Testing

- Range of servo hydraulic actuators and test machines.
- ‘Hardware in the loop’ testing
  - Real components running in a computer model
  - Allows track inputs in real-time.
- Instrumentation and data collection.
- Development of dedicated test rigs and software.

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Expert Services & Project Co-ordination

- Worldwide contacts with railway engineering experts.
- Extensive experience of co-ordinating collaborative projects linking industry and universities.
- Organisation of industry conferences / seminars.
- Database of specialist railway expertise

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Rail technology transfer

www.database

RTU TEAM	COMPUTER SIMULATION	PUBLICATIONS	BENCHMARKING
PROJECTS	COMPONENT TESTING	ROLLER RIG	OUR DATABASE

- Details of specialist expertise within each institution.
- Details of existing rail industry related training courses / modules
- Contact information via an interactive database of contacts.
- Hyperlinks to the relevant web site where available.

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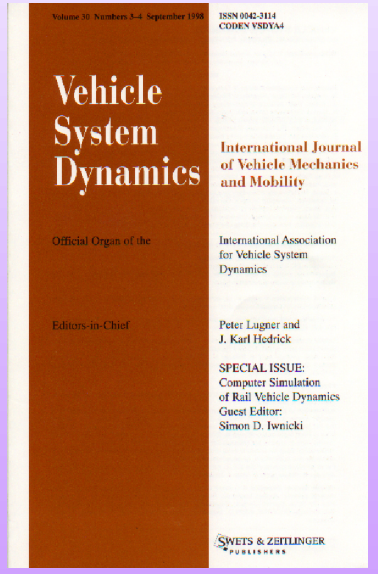
Benchmarking

- Benchmarking undertaken for rail vehicle simulation packages
- Soon to be published in ‘Vehicle System Dynamics’



- ADAMS Rail/MEDYNA
- SIMPACK
- VAMPIRE
- GENSYS
- NUCARS

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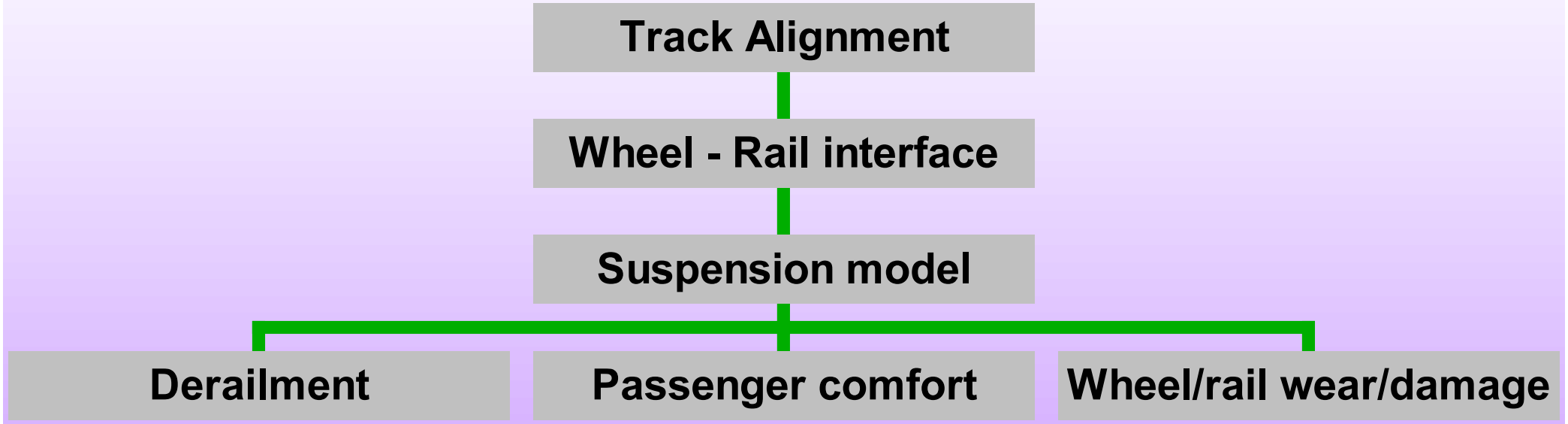
Computer modelling



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Freight vehicles modelled

HAA coal hopper wagon

BYA COIL CARRIER WITH
SWING MOTION BOGIES

102 TONNE STONE HOPPER
WITH LTF BOGIES

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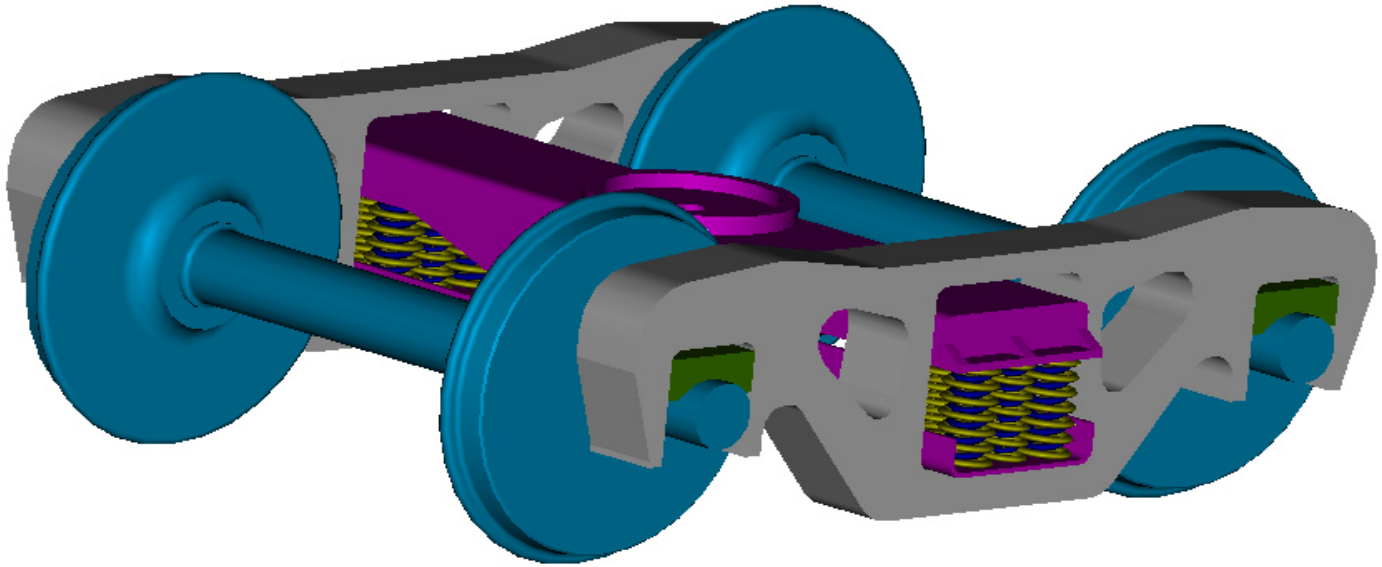
3-piece freight bogie



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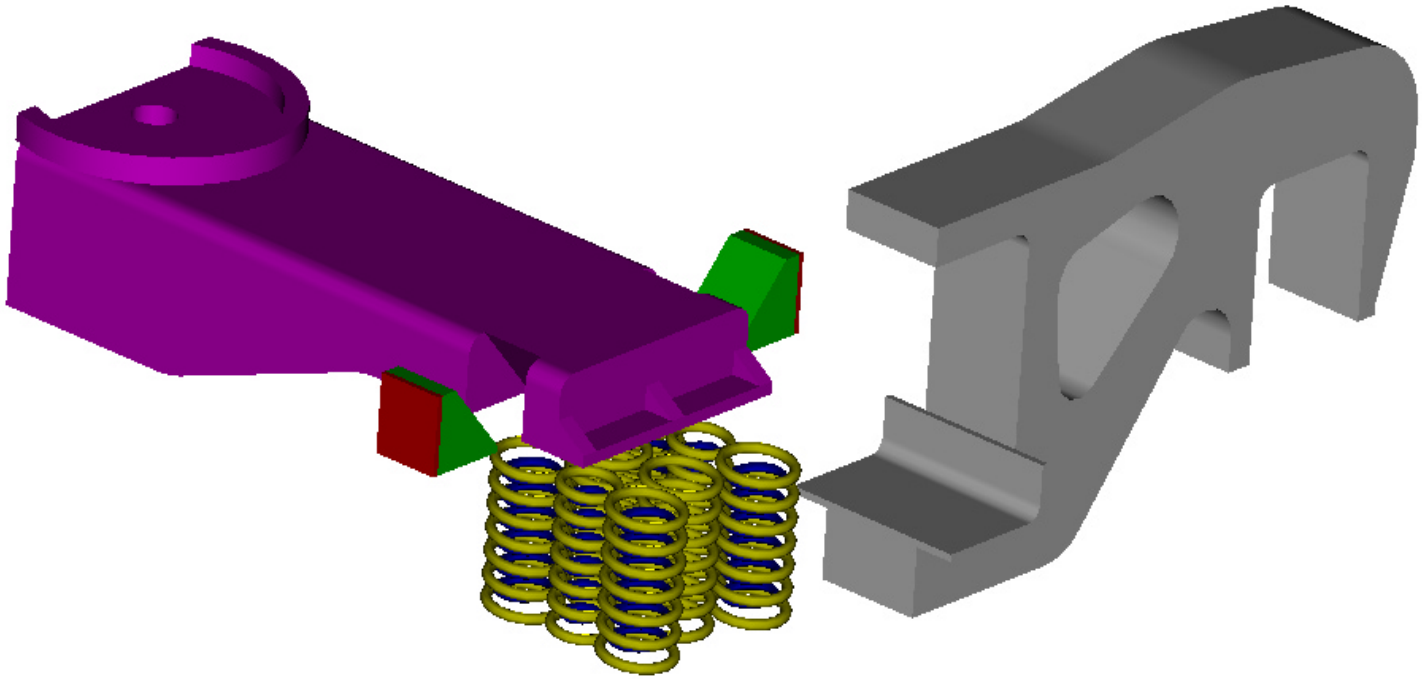
Friction damping system 3-piece bogie



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Locos & Coaches

MK3 COACH BT10 BOGIES

CLASS 43 High Speed Train Locomotive

CLASS 86/0 LOCO

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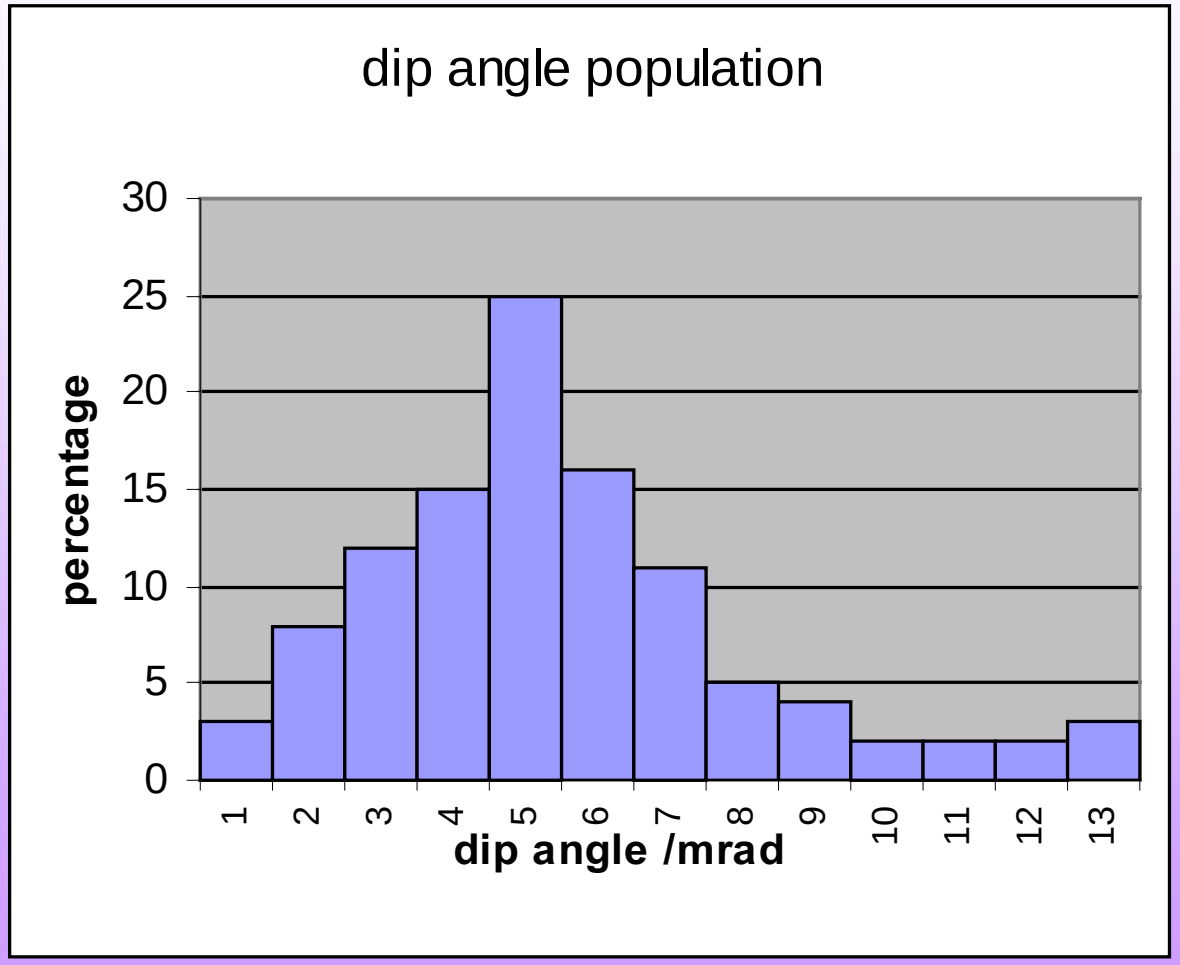
Size of dips



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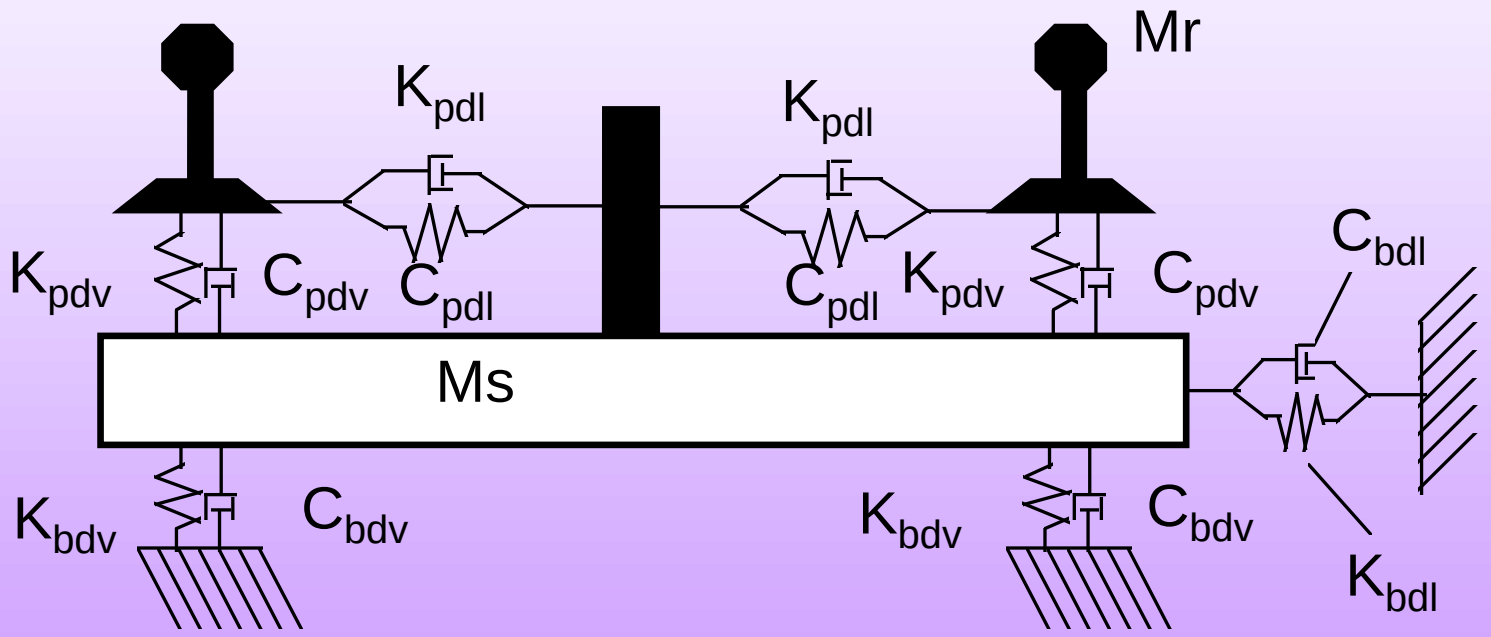
Track Model



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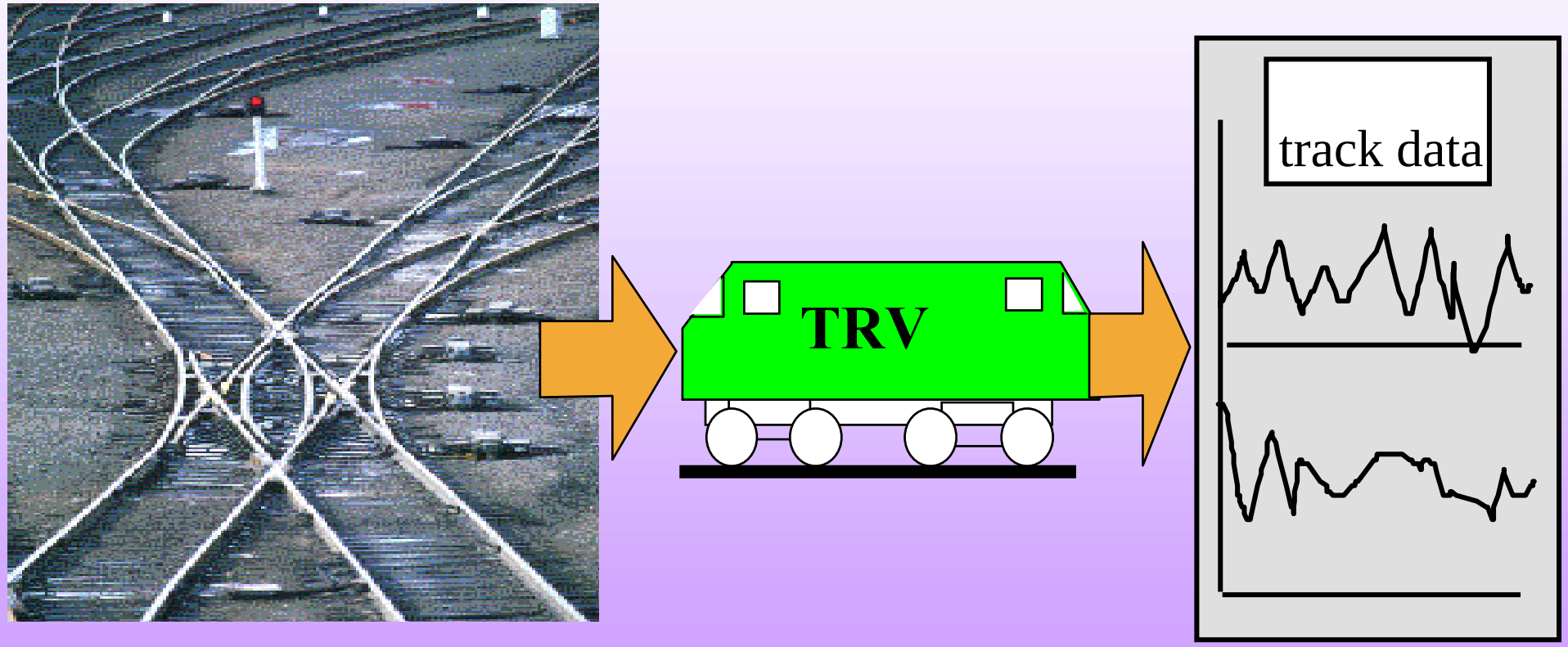

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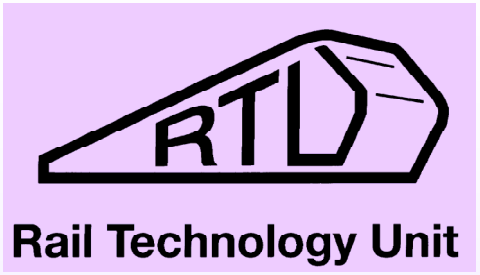

Track Damage Prediction

Project Overview

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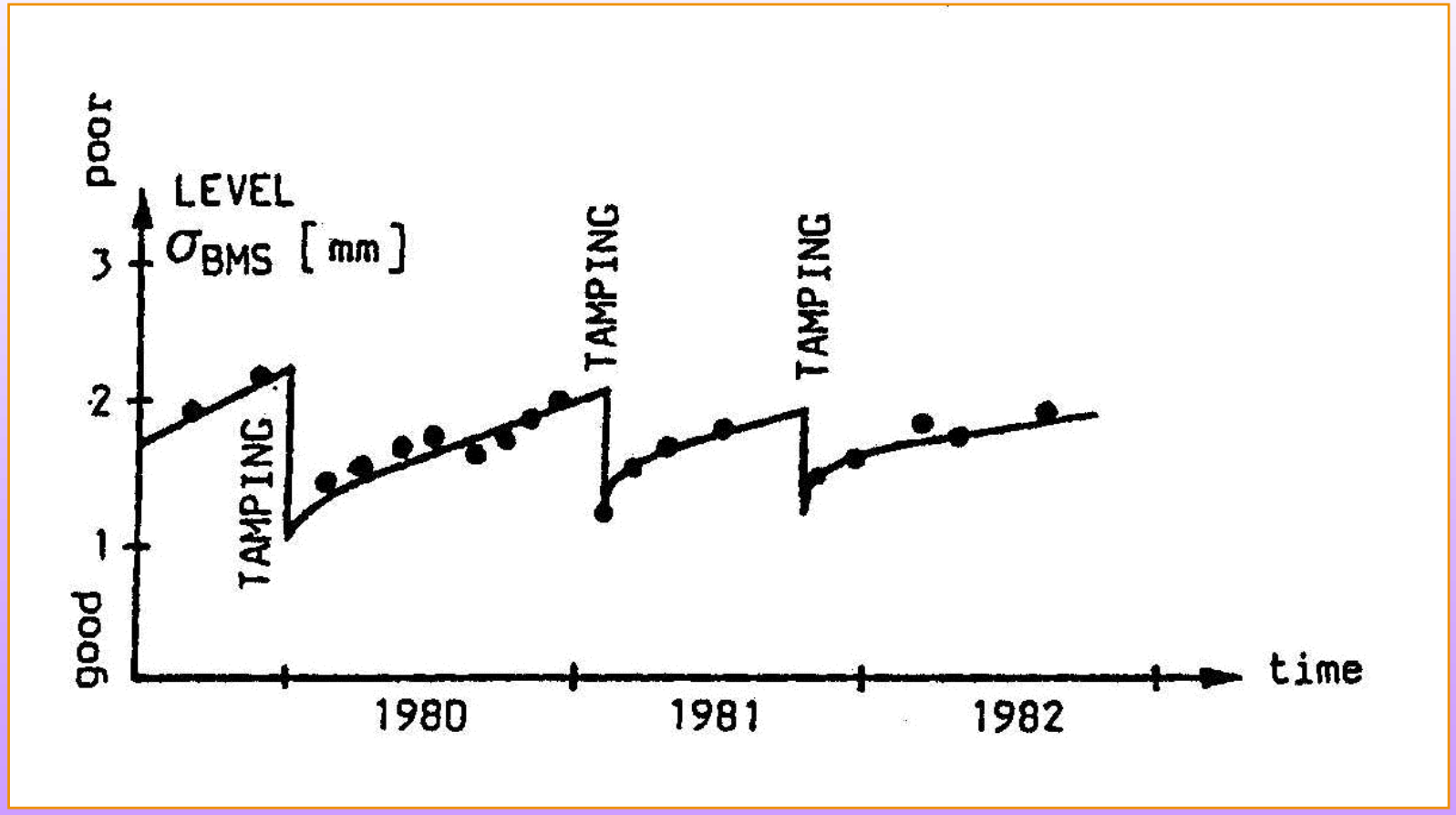
Track Deterioration



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Track Settlement

ORE deterioration model

A statistical model with no track parameters which uses traffic volume, dynamic axle load and speed raised to the power of empirically derived factors.

Power law

Used by several railway organisations to predict track deterioration ballast pressure is evaluated and raised to the 2^{nd} (optimistic) or 4^{th} (pessimistic) power.

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Track Settlement

Sato

Japanese measurements from track recording vehicles over many years have led to and empirical track settlement model based quasi-static ballast pressure and ballast acceleration together with vehicle speed and tonnage and factors for track type.

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Track Settlement

TU Munich settlement model

Experiments under well controlled laboratory conditions have been used to establish equations to calculate rate of settlement. Ballast pressure is multiplied by the log of the number of axle passes as follows:

$$S_{opt} = 1.57.p.\Delta N + 3.04.p^{1.21}.\ln N$$

The first part of the equation relates to the initial settlement immediately after tamping and the second part relates to the longer term and more gradual settlement after about 10,000 axle passes.

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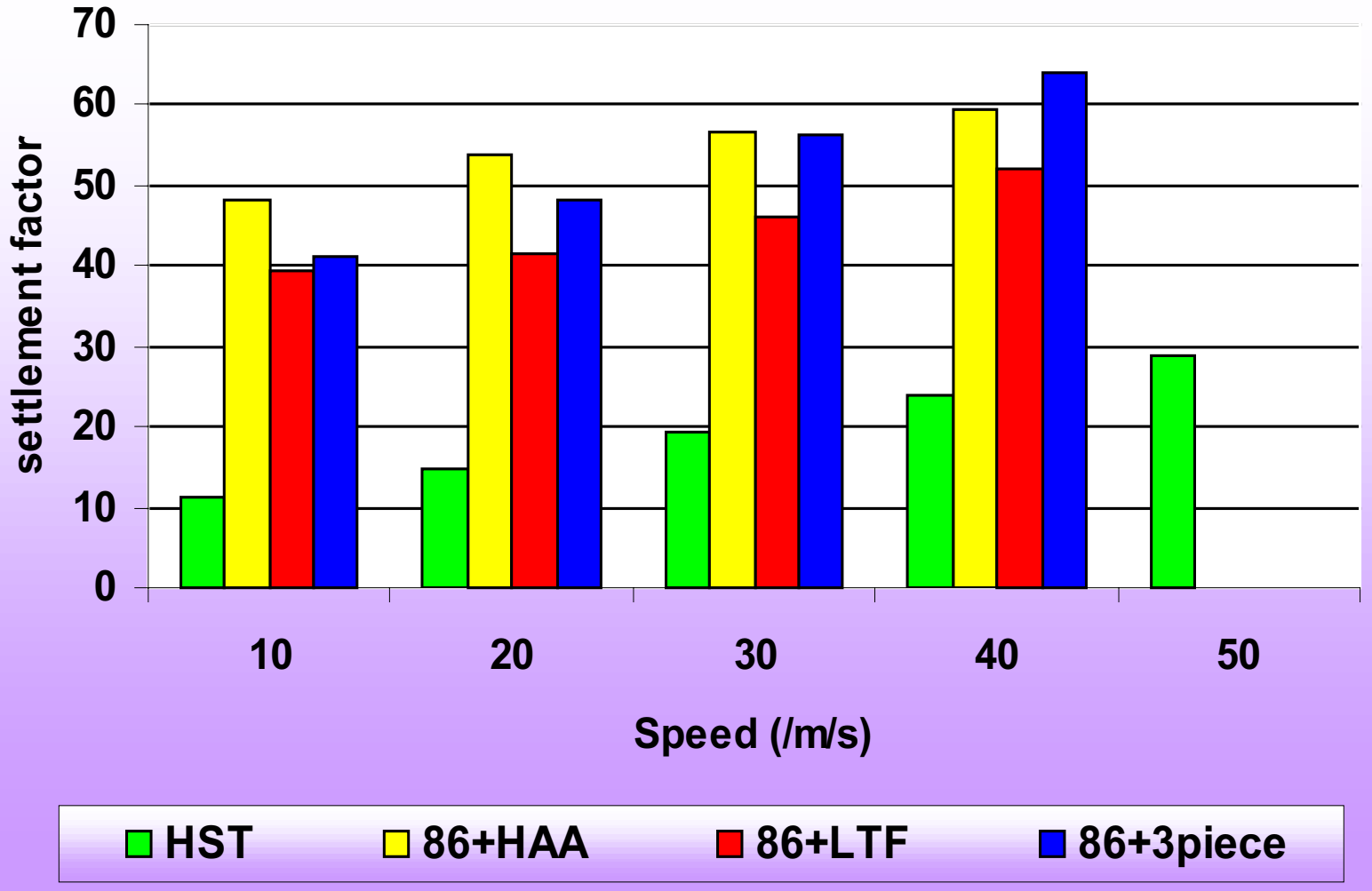
Track settlement factor (per train) on 5 mrad dip



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Summary

- Rate of settlement can be predicted from track force.
  - -could be modelled or measured.
- Track force is sensitive to suspension design.
  - -especially suspensions including friction damping.
  - -current Mini-MARPAS model uses two linear coefficients.
- Costing per vehicle can be derived from rate of settlement.
  - -data relating to changing SD, traffic and tamping cost required for a section of track

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