‘Gröna Tåget’ Technologies

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Banverket
Bombardier Transportation
SJ
Green Cargo
SL
Interfleer Technology

- 20 senior researchers
- 18 PhD students
- 16 PhD exams since 1999
- Approx. 60 scientific papers annually
- Turn-over > 1.5 MEuro

EURNEX
Railenergy
Background

- A replacement of X2000 has to be initiated within the next years.
- Large investments in new rail infrastructure are made until 2015.
- The project name refers to the inherent capacity of the railways to contribute to a sustainable transport system through high capacity, high energy efficiency, high safety and low emissions.
Objectives

- To develop the prerequisites for the next generation of Swedish high-speed trains
- To strengthen the ability to influence European rail research and standardization
- To improve research collaboration between universities, research institutes, Banverket, Swedish rail operators and Swedish industry
International comparison

Average train speed according to time-table

Source: Railway Gazette Internat’l

Year
Characteristics of a new Swedish high-speed train

- Shorter travelling time
  Maximum speed at least 250 km/h
- Less environmental impact
  Noise and energy
- Improved comfort
- Reliability in winter climate
- Lower cost
  Capital
  Maintenance
  Energy
  track fees
  etc
and...

- Low track forces
- Relatively short trains that can operate in multiple
- As much as possible follow European standardisation
- The Swedish high-speed train must be part of an all-European train where special Swedish requirements are integrated by modularisation.
‘Gröna Tåget’ projects

• **Track friendly Bogies**
  Radial self-steering bogies
  Mechatronic bogies

• **Active secondary suspension**

• Aerodynamic optimization of the train front
  Slip stream and front shape for wide body trains
  Design of high-speed trains to avoid instabilities at sudden cross-winds

• **External noise reduction**

• **Energy consumption**

• **Permanent magnet traction motors**

• **Optimal tilting**

• **Vertical contact forces**

• ...
Track friendly bogies

- Passive radial steered soft bogie

- New design of:
  - Primary suspension
  - Bogie frame
  - Yaw damper

- Mechatronic bogie

- Actively controlled radial steering

Lateral track forces “half” of UIC limits
Active secondary suspension

- **Hold-off device** to centre the car body
  A wider car body is permitted
- Improved passenger comfort
- Different actuators have been considered
  Electro-mechanical
  Electro-hydraulic
External noise reduction

- Bogie skirts for lower external noise and lower energy consumption
- Low noise screens along the track
Energy consumption

- Target: Reduced energy consumption per seat-km by 25-35% (compared to X2000) despite an increase in maximum speed from 200 km/h to 250 km/h
- A corresponding reduction in CO2 emissions is obtained.
- KTH studies show that a reduction in the range of 15-30% is feasible depending on the width of the car-body and thus the number of seats.
- For a wide body train that is approximately 0.052 kWh per passenger-km (“cabin factor” 60%)
Permanent Magnet Motor Technology
-from emerging technology to state-of-the-art

- Fixed speed applications
- Robotics
- Wind Power
- Electric and hybrid electric vehicles
- **Electric Railway traction**

*Four-quadrant energy converter for hybrid electric vehicles*
Permanent Magnet Traction motors
– general characteristics

• Higher efficiency than comparable Induction motor drive (2-3%)
  Lower losses in the rotor
  Simpler cooling
• High torque density
  – Lower weight OR
  – Improved performance can be obtained for a given weight and volume
• A high pole-pair number is possible thus making a direct drive feasible
• Synchronous motor, in general single-axle drive
• Application and system issues are important
• More specific information will be given at the afternoon presentations