BiHSP 2004/2005

Intelligente Verfahren zur
Regelung von Fahrzeugen und Fahrzeugkomponenten

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Project timetable:

- 2004-2005/ Sep-Oct, Sarajevo

Theoretical research :

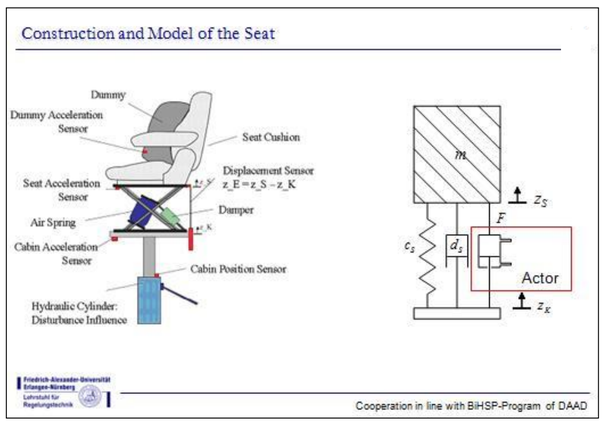
- Field: Artificial Intelligence
- Field: Control Engineering

Practical implementation :

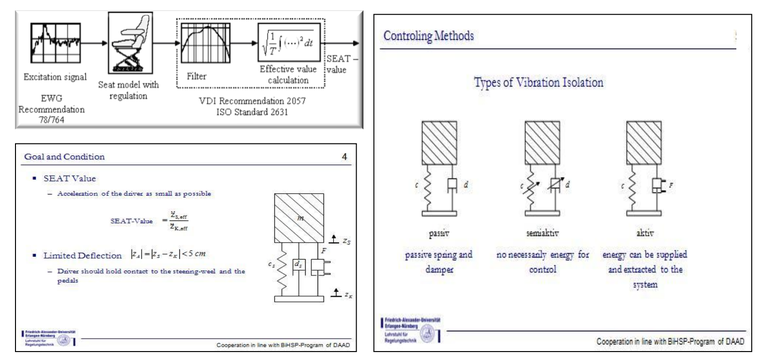
- MATLAB- SIMULINK
- Neural Network Toolbox
- Fuzzy Logic Toolbox
- dSPACE Hardware

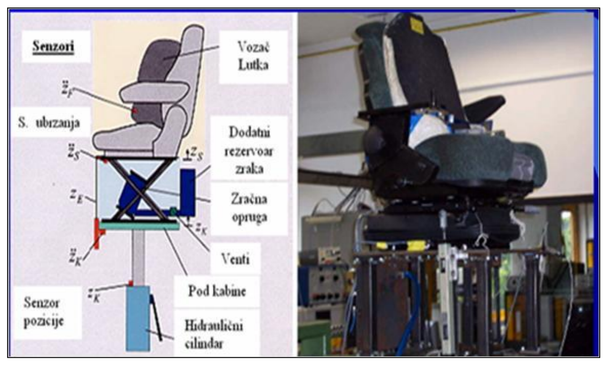
Project destription

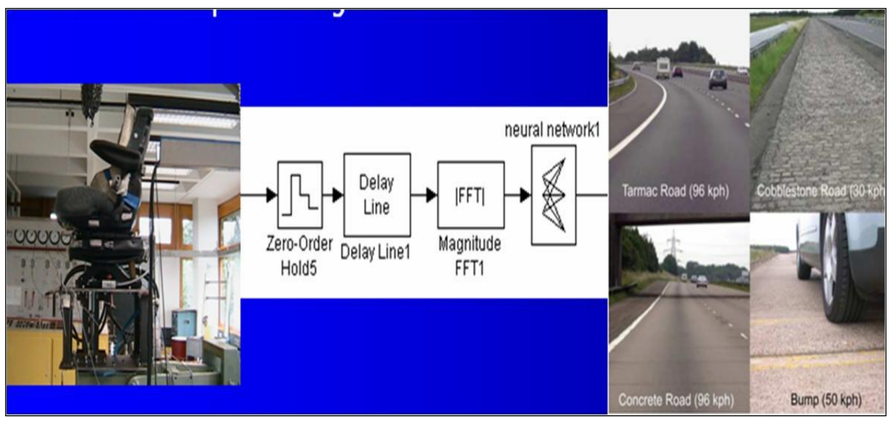
This project examines capabilities of Artificial Neural Network (ANN) regarding control of a heavy vehicle seat with semi-active damper. Matlab and its sub-application Simulink are used as a tool for developing simulation model of the driver seat in the heavy vehicles. The seat model with semi-active damper is built modularly by forming each of its components separately. Designed control model was tested in Matlab/Simulink, and then was verified on experimental setup, installed on the Department for Automatic Control of the Friedrich Alexander University in Erlangen - Nürnberg. After introductory remarks, this work considers description of the seat with semi active damper including mechanical characteristics and mathematical description of major components, theoretical remark about ANNs, control system description and implementation on experimental setup, using dSPACE module.

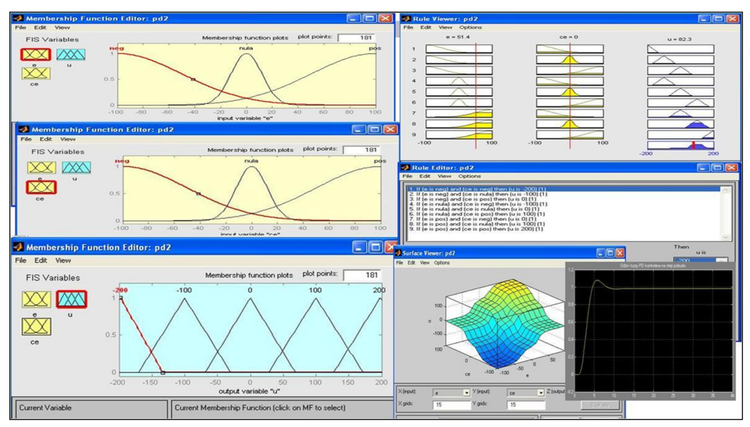


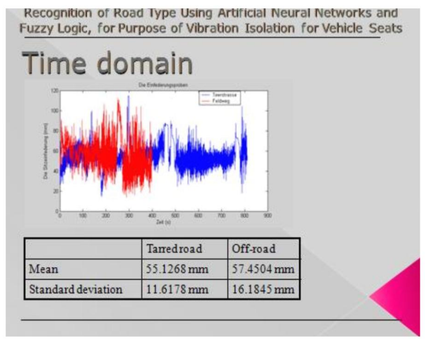
Wheel suspension of heavy-duty vehicles is very stiff or doesn't even exist. During the drive of such a vehicle, vertical oscillation appears. These oscillations have impact on driver body, but they can be reduced using air spring and damper. Figure shows experimental setup, which is installed in Department for Automatic Control of the Friedrich Alexander University in Erlangen - Nürnberg. To make experiment more realistic, 75 kilograms weight dummy is used as a substitution for driver.

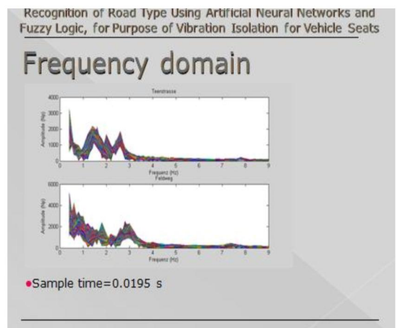


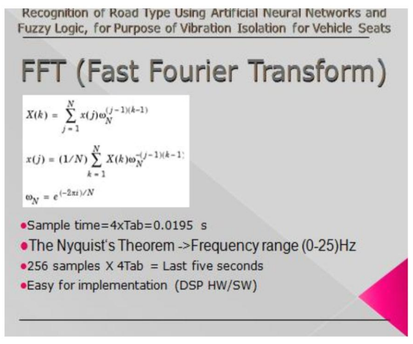


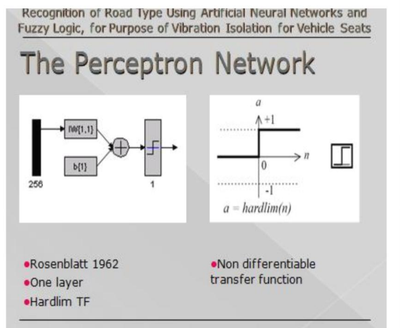


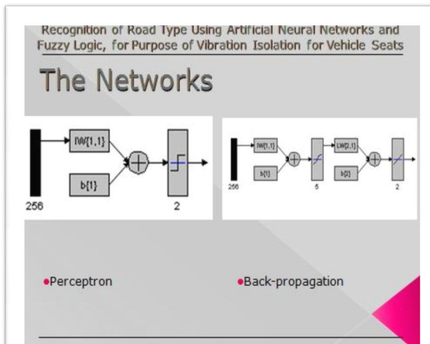


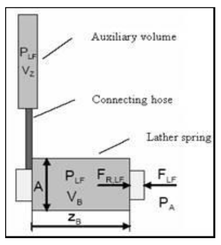


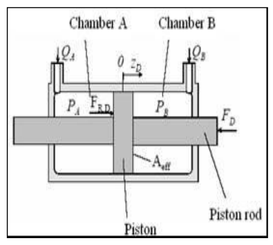






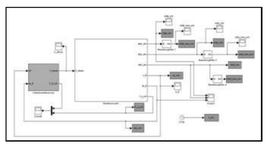


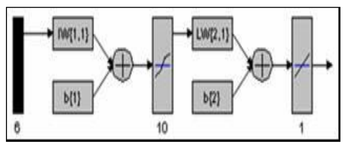




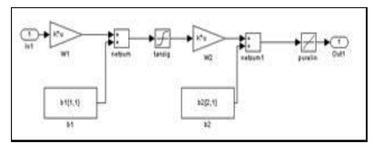
Damping force F_D can act only in piston movement direction. It is not possible to have piston movement in one direction and to produce force in opposite direction only with valve closing and opening. This could be achieved only with active damper, with his own oil pump for producing high pressure and getting force in direction opposite to the piston movement.

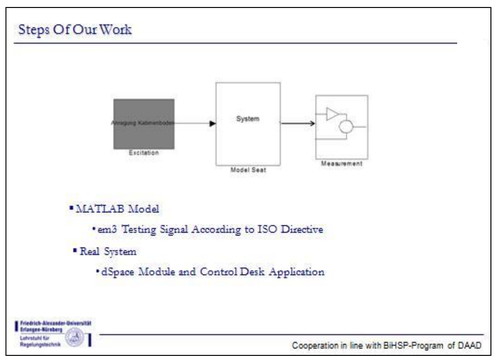
Simulink model of the seat with semi-active damper. Two blocks are dominant. First block is for damping control, and second one is a seat model.

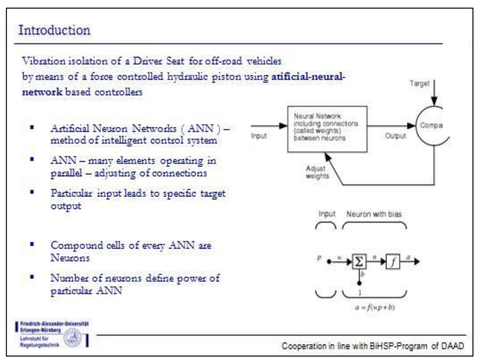


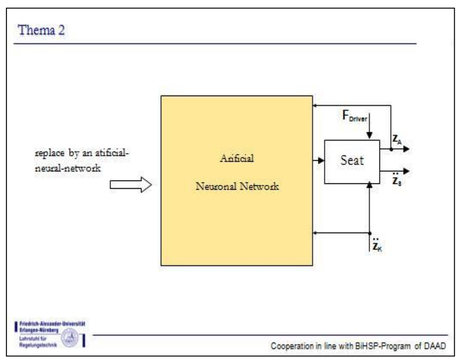


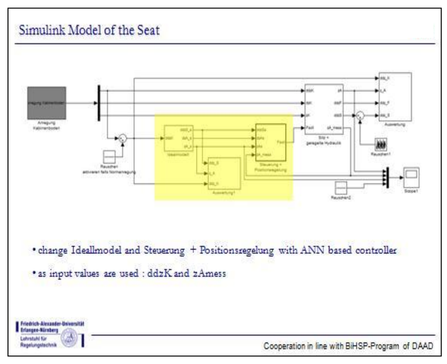
This kind of ANNs can approximate any functional relation between input and output, with one condition that hidden sigmoid layer has realised with ceratain number of neurons. This ANN can be modeled by using blocks in Simulink.

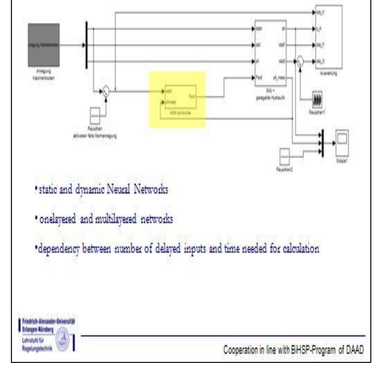


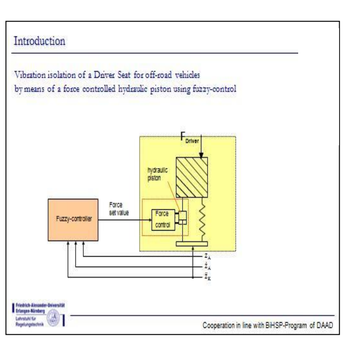


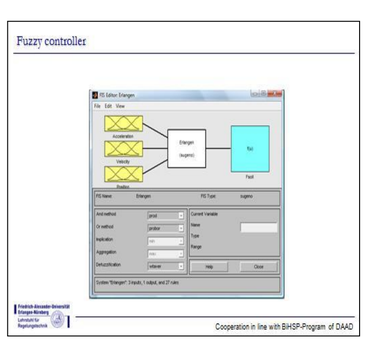


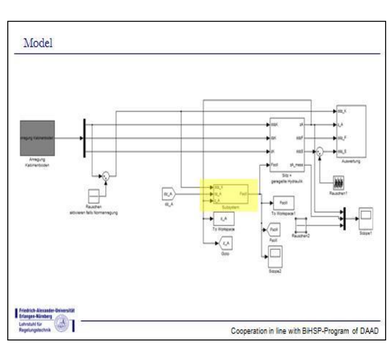


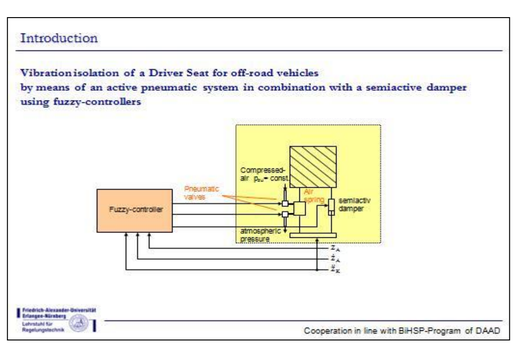


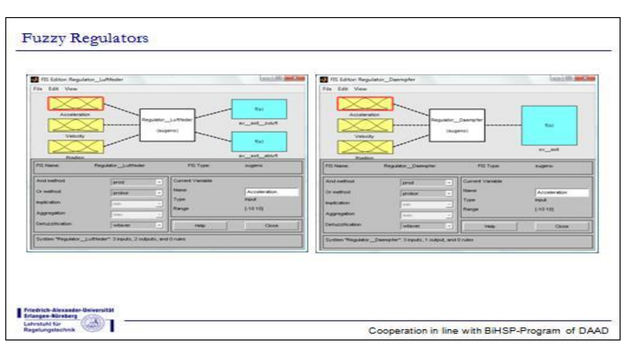


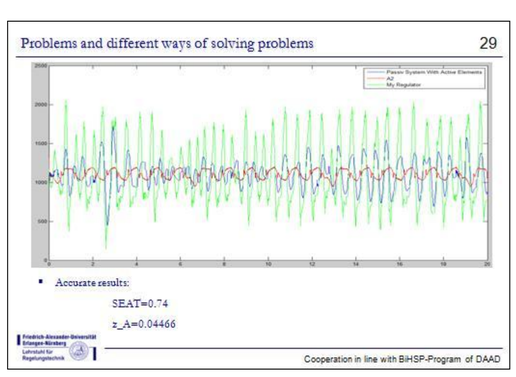


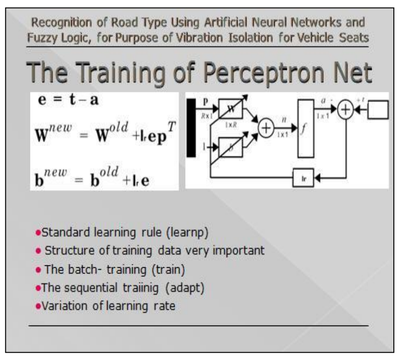


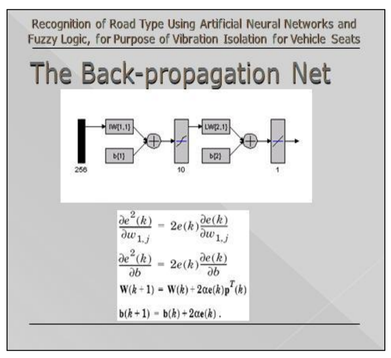


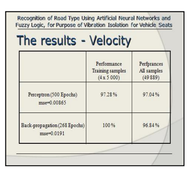




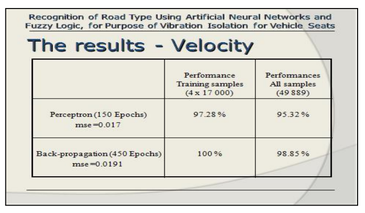


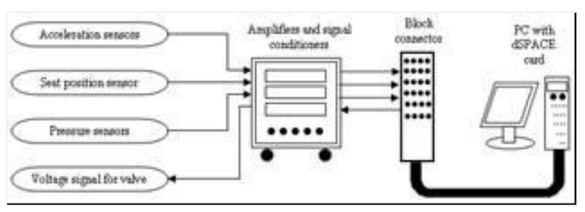


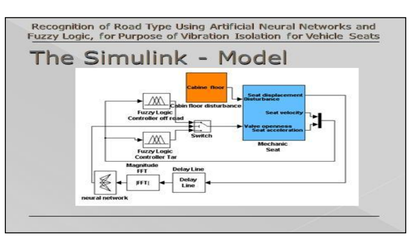


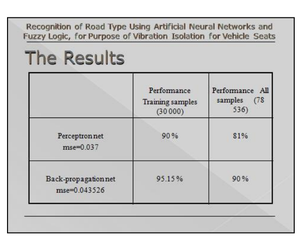


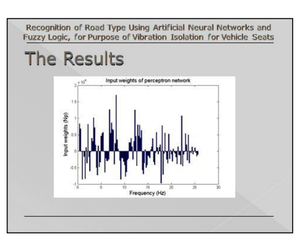
As interface between computer and experimental setup dSPACE card is used. That is series of AD converts for inputs, and DA converts for outputs from the computer. Signals from sensors on experimental setup, through series of amplifiers and signal conditioners, and through block connector are taken into dSPACE card in computer. Similar, output from dSPACE card, for example voltage signal for valve control, through amplifiers is brought to the valve. This makes possible to control valve flow diameter using computer. Figure shows schematic view of experimental equipment connections.

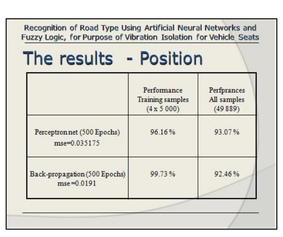


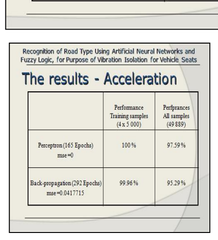












Using Matlab it is possible to compile Simulink model and to adapt it to dSPACE module, creating digital connection between model's inputs and outputs, and inputs and outputs of experimental setup. Compilation of the Simulink model is done by the use of command *Build Model* , which results in series of files, required for dSPACE card. Those files contain definitions of all variables which are used in Simulink model and definitions of mutual connections for all Simulink blocks.

Figure shows acceleration of the real seat, on the experimental setup, using ANN controller.