



A NN - Toolbox-based Solution to ARGESIM Comparison C18 ,Neural Nets / vs Transfer Functions' with MATLAB/SIMULINK®

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Simulator: MATLAB is a widely used software tool based on numerical vector and matrix manipulation. This comparison was solved with SIMULINK, which is a MATLAB-toolbox for graphical modelling and numerical simulation of continuous and discrete systems.

Task a - Identification with linear model. A discrete transfer function block was implemented in Simulink, and the MATLAB function `fminsearch` was used to identify the parameters of the 2nd order discrete-time model (given below). Figure 1 shows that the general system dynamics can be described by the linear model (given below), but details are not matched:

$$G(z) = \frac{0.5441z^2 - 0.5405z}{1.044z^2 - 1.6285z + 0.5891}$$

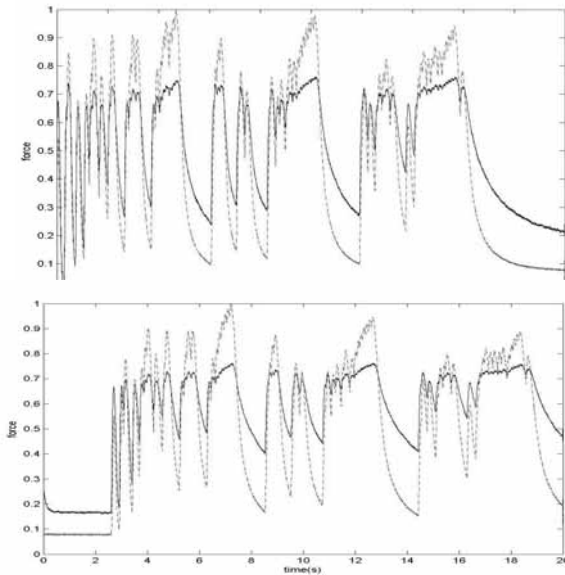


Figure 1: Simulated (solid line) compared with measured force (dashed line); training set- above, validation set- below

Task b - Linear model with ANN in parallel. A network structure with seven neurons in the first layer and one neuron in the output layer was described in SIMULINK (using the Neural Network Blockset) in parallel to the linear discrete model (Figure 2).

After training, the neural net 'compensates' the nonlinearities in the data, which cannot be matched by the linear model, well. Results are similar to task c, also with similar least square error.

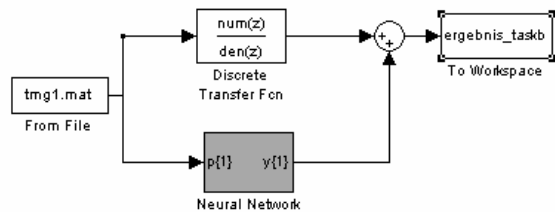


Figure 2: Top-level model representation of task b.

Task c - Identification with dynamical ANN. Again, the network, now a dynamical one, can be directly described and trained in SIMULINK (Figure 3).

The network input is the measured muscle thickening and the target is the muscle force. The results are presented in Figure 4.

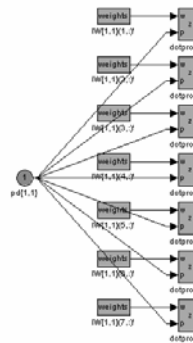


Figure 3: Structure of the first layer of the dynamical Neural Network in SIMULINK.

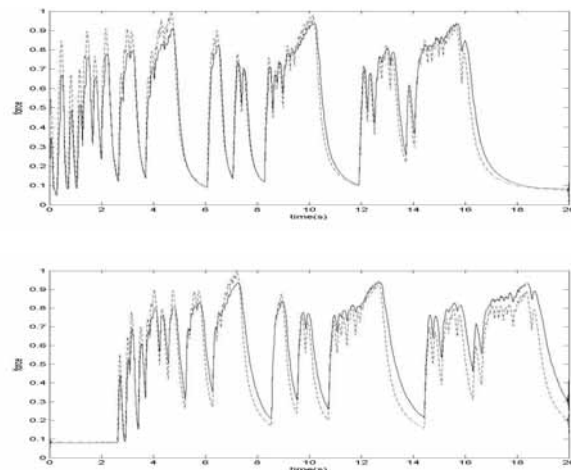


Figure 4: Simulation of the neural network model (solid line) compared with measured force (broken line). Training set- above, validation set- below.

C18 Classification: Graphical NN Toolbox - Approach
Version: MATLAB / Simulink Rel. 14 SP2