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# Mannequin Properties Desired for Ergonomic Evaluation of Car Interiors

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In the EC-project ANNIE – Application of Neural Networks to Integrated Ergonomics – (Brite Euram), the aim is to show the feasibility of using trained neural networks to control mannequins for simulating activities. As an end product, ANNIE will be used as a design tool for ergonomic evaluation of virtual workplaces and work cycles. One application is the design of car driver interior environments, in which important characteristics are safety and comfort.

The aim of this pilot study was to simulate the future mannequin using human subjects. Mannequin properties and data evaluation methods were to be investigated against the recorded data. Means of presenting data to the designer using ANNIE were also to be studied. Finally, the collected data should serve as training data for the neural network.

Eight subjects were put to drive a mock-up car. The steering wheel, throttle and brake pedal were connected to a car-racing computer game. The driver's view was projected onto a large screen in front of the driver. Subjects were asked to perform the following tasks on command: answer a cellular telephone placed in the glove compartment, adjust the temperature, insert a cassette located on the dashboard into the car stereo, and eject the cassette and bring it back onto the dashboard.

Kinematic data were continuously and simultaneously sampled using a variety of techniques: An ELITE-system (a video technique using IR and passive markers on different places on a person) for the upper body movements, goniometers for wrist movements, inclinometers for head, back, and upper arm movements, electromyography (EMG) for the trapezius muscles, and heart rate using electrocardiography (ECG). Eye movements were recorded using the SMI eye tracker. Data collection was designed to allow for synchronisation of all data.

Data were analysed with respect to the possibility to record them from a mannequin, and to their usability to the future mannequin user. For instance, a mannequin from which the user can extract absolute angle data is relatively easy to implement, and allows the use of established

ergonomic evaluation methods, such as RULA and comfort zone analysis. Relative angle data is just as easy to extract, but there are almost no evaluation methods. On the other hand, constructing a mannequin that provides EMG and ECG data leads into unrealistically complex calculations of muscle tension and heart rate. Eye movements cannot be realistically simulated in a mannequin without a complex cognitive model. Yet, all three are important in ergonomic evaluations (as exemplified in the paper).

A clear advantage of mannequins is the possibility to immediate analysis and presentation of generated data, using colour coded diagrams, plots, tables, pictures, ergonomic evaluation scores, and comparisons to reference material. This could be particularly useful for studies of synchronised data. In the paper, we exemplify useful synchronisation with hand-eye co-ordination, body angles, ECG and EMG for evaluation of driving safety and comfort.