Blended-Learning in Teaching Model-Based Design of Mechatronic Systems

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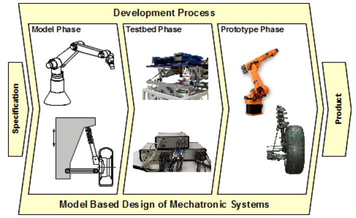
Motivation

- **Aim:**
  Teaching model-based design of mechatronic systems
- **Development process: beginning with the requirements the**
  - model-
  - testbed- and
  - protoypephase

  are run through; mostly with backspaces until the product status is reached



- **Every phase is characterized by a series of experiments and model refinements**

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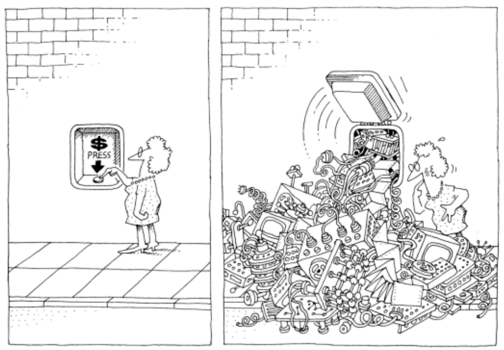
The task in the development of complex systems



The task of the software development team is to engineer the illusion of simplicity.

Reference:
G. Booch, Object-Oriented Software Design
Addison Wesley, Menlo Park , 1994.

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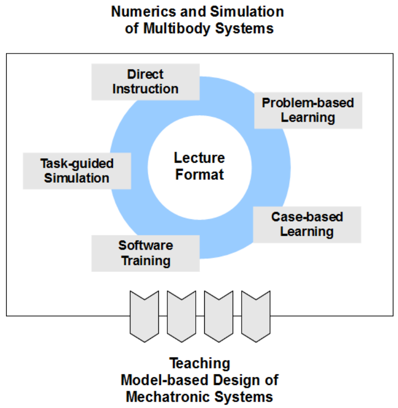
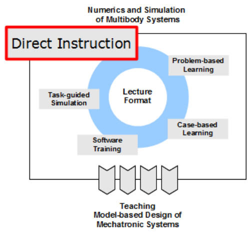
Knowledge transfer in model-based design of mechatronic systems: The lecture format



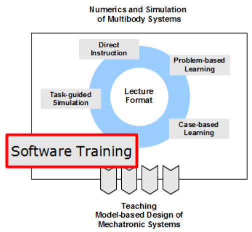
Elements of the Lecture: Direct Instruction

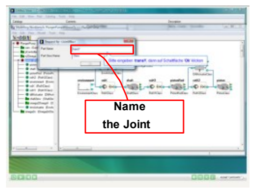


- Presentation based frontal teaching imparting
  - concepts and
  - methods
- Tablet-PC based frontal teaching for
  - a step-by-step introduction
  - derivation and
  - working out

of physical/mathematical facts of MBS dynamics

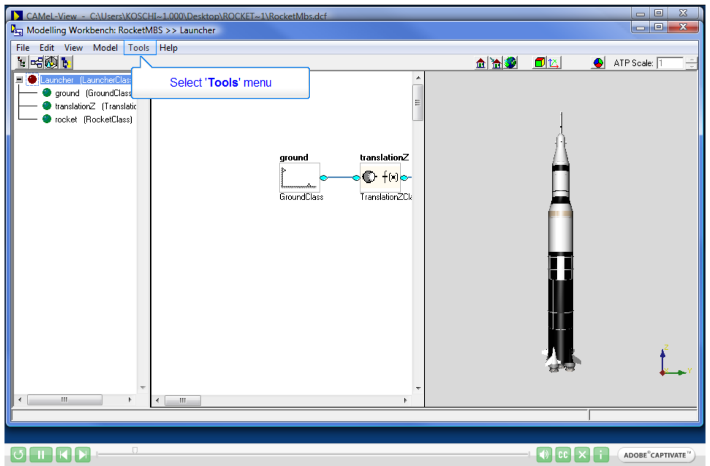
Elements of the Lecture: Software Training with Software Simulations



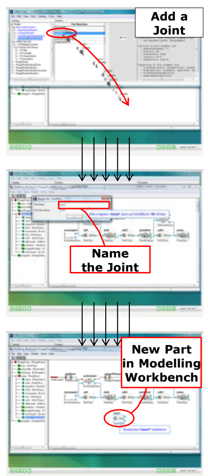


- System design is increasingly computer-aided
- Teaching model-based design of mechatronic systems with CAE-Software is a basic
- Students should do model-based design on
  - their own and
  - their own computer
- Design environment supporting all 3 phases of the model-based design of mechatronic systems:
  - CAMeL-View
- Teaching units in the form of software simulations

Software simulations: An example ...

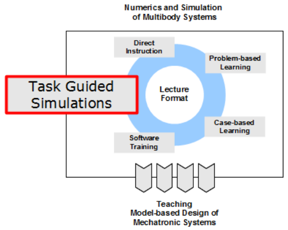


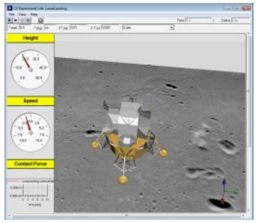
Advantages of Software Simulations



- A well designed storyboard allows the perfect combination of theory, practice, and application
- Releave the lecturer
- Allows to concentrate
  - on the aspects that show the interdependencies between the individual steps
  - the mathematical/physical background
- The base quality of a software simulation based lecture is always the same
- Allows to step back in the lecture
- Allows the students after the lecture to replay the software simulation and learn themselves
- Internationalization is easy possible

Task-Guided Simulations with MBS Experiment-Environments





- **Experiment Environments based on physical models allows to study**
  - dimension system components
  - dynamic systems behavior
  - physical basic dependencies
  - test the fulfilment of the main functions
- **Unlimited virtual laboratory space**
- **The students can experiment themselves@home**

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Example Experiment Environment

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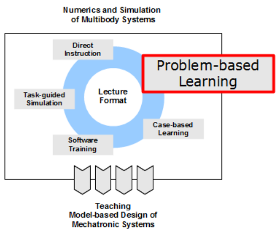
Problem-Based Learning by Course-Accompanying Project-Tasks



- Information provided by courtesy of the Kennedy Space Center ATX Team :-)) :
- It's made up of 3 rings and a cage where the participant is sitting
- The outside ring is stationary and anchored to the floor. It is 3 inches wide, 8 inches thick and measures 9 feet 2 inches from outside edge to outside edge
- The second ring is attached to a motor via a belt and turns at about 60 rpm. This ring is 3 inches wide, 8 inches thick and measures 8 feet 2 inches from outside edge to outside edge
- The third ring moves freely. This ring is 3 inches wide, 8 inches thick and measures 7 feet 2 inches from outside edge to outside edge
- The cage also moves freely and measures 5 feet 6 inches from top to bottom and 6 feet 8 3/4 inches from pivot point to pivot point

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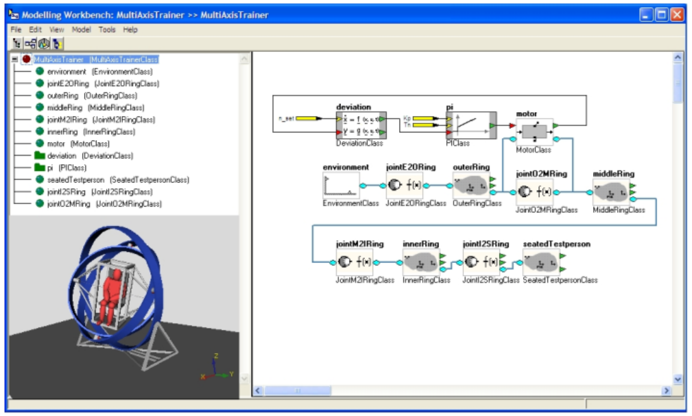
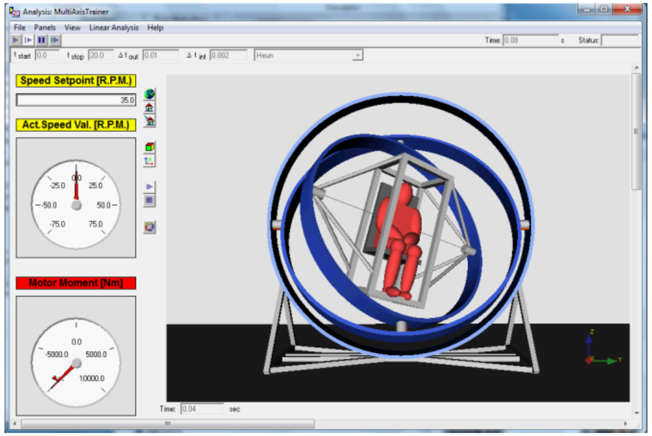
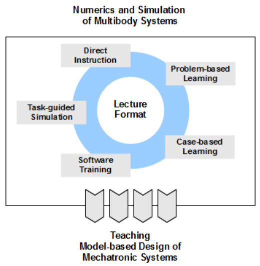
Example Model of the multi-axis trainer project task



Example simulation model of the multi-axis trainer project task



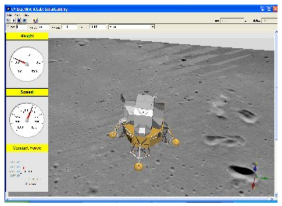
Summary



- **Presentation of a modern lecture format teaching model-based design of**
  - mechatronic systems
  - especially Multibody Systems
- **Successful used elements**
  - direct instruction
  - software training with software simulations
  - task-guided simulations with MBS experiment environments
  - Problem-based Learning by course-accompanying project tasks
- **Teaching model-based design with CAMeL-View a modern, object-oriented design environment for the design of mechatronic systems**

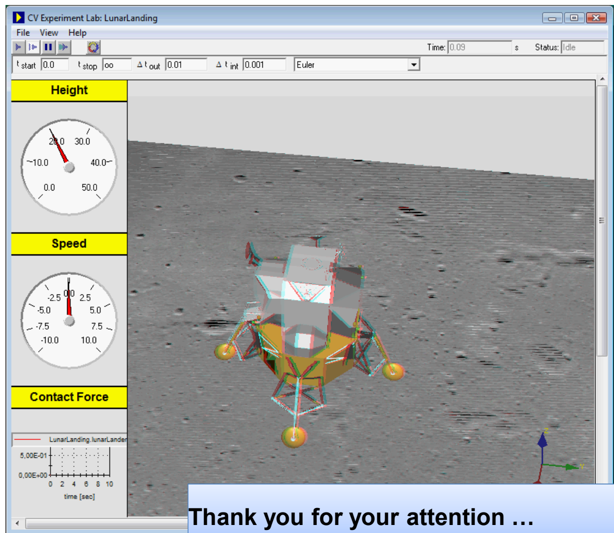
Outlook and further Information

- **Extension to other courses e.g. optimization of mechatronic systems**
- **More examples and better integration into e-learning environments (e.g. Moodle)**
- **If you like more information about**
  - Software Simulations with Adobe Captivate
  - Modelling and Simulation of mechatronic systems with CAMeL-View
  - Creating Simulators and Experiment Environments using CVExperimentLab



please contact me (martin@mhahn.name), have a look to my private website (www.mhahn.name) and especially to

www.mhahn.name/REM2011



Thank you for your attention …