20. **Walther Neuper**

Engineering mathematics -- intuitive and formal

Systems based on technology from (Computer) Theorem Proving (TP) excel at formal rigor, at reliably and generously checking user input and at ensuring correct results -- advantageous features for educational systems. Isac, a prototype of such a system, additionally supports stepwise problems solving by use of Lucas-Interpretation.

Isac's conception works out nicely in "pure mathematics", where problems are formally specified. Here the whole process of problem solving can be covered: the model-phase, the specification-phase and the solve-phase (more about these phases below). In all three phases the student gets support in stepwise interaction similar to traditional paper-and-pencil work; support means reliable check of input and "next-step-guidance" (the systems suggests a next step if the student gets stuck).

However, physicists and engineers generally follow a more intuitive and less formal approach --- now, how can a system like Isac cope with these requirements? The talk will illustrate ideas by examples:

Model-phase (aims at a formal model of the problem at hand): Engineering problems frequently are described by use of figures depicting forces, torques, directions, etc. The idea is to make respective figures interactive, such that forces, distances, etc. can be interactively attached at certain places.
Specification-phase (relates model and sub-problems to knowledge mechanised in the system): sub-problems shall be moved into the electronic worksheet, arranged and connected, while Isabelle/Isac's type system helps to check the connections.
Solve-phase (interactively construct steps towards the result): So far all steps have been formally justified by some theorem (or a combination of theorems). The idea is to extend these justifications by lines of prose. How these shall be handled and relate to the requirements of TP is under consideration.

The ideas mentioned above are pursued in a R&D-project in cooperation with Universities of Applied Sciences in Austria.