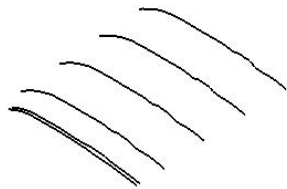


The page containing the illustration of results consists of a picture of the real door taken in the machine lab, a spline model in Maple® (in one direction) , a model constructed in the CAD system Pro/Engineer® and a picture of the produced part. Except for the CAD model, these are depicted below:



Real Audi A2 door



Spline model in Maple®

The solution documents produced by students contain a documentation and a Maple® worksheet. Sometimes there is also a Powerpoint® presentation available.



Produced part

Current Status

Currently, the project server contains 13 project classes and 20 project instances for mechanical engineers (as of June 2003). By the end of 2003 it is planned to have about 40 projects in the database. Colleagues are cordially invited to use the server for finding adequate projects for their students and to contribute projects themselves (possibly including some password-protected solution material).

Literature & Contact

- *Alpers, B.:* Mathematical application projects for mechanical engineers – Concept, guideline and examples, Borovcnik, M., Kautschitsch, H. (Eds.): Technology in Mathematics Teaching, Vol. 2, Proc. ICTMT 5 (Klagenfurt), öbv&hpt, Wien 2002, 393-396.
- *Alpers, B.:* MAPS - A Mathematical Application Project Server, Hibberd, S., Mustoe, L. (Eds.): The Mathematical Education of Engineers IV, Proc. IMA Conference April 2003.

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MAPS Mathematical Application Project Server

The problem

It has been stated quite often that an adequate mathematical education of engineering students should enable them to apply mathematical modelling in solving an application problem of interest. Integrating mathematical application projects (or “case studies”) in the curriculum has been identified as one way to achieve this qualification. Several examples for such projects can be found in literature, and their potential for motivating and activating students has been demonstrated frequently.

Nevertheless, such project work has not been widely integrated into mathematical curricula for engineers. Beside the problem of assessing particularly the work of student groups, a major obstacle seems to be the necessary effort for identifying ever new “good” application projects such that students cannot simply copy the work of former student generations (as is often the case in traditional physics labs).

The MAPS web server addresses this obstacle by providing means to ease the work of an instructor to find good projects for his/her students.

Concept of MAPS

MAPS is based on the class-instance metaphor which has been adopted from object-oriented software development. As in that area, the essential idea behind this is re-usability. Projects (also called: project instances) are grouped into so-called project classes. A project class extracts the essential aspects and abstracts from the specificities of a concrete project (instance). For example, a project task might consist of constructing a special motion curve around obstacles fulfilling additionally some properties (restrictions on curvature, e.g.) whereas the underlying project class describes

motion design tasks in general. The class description serves to facilitate the process of finding similar projects “of the same kind” by explicitly specifying its characteristics.

The class definitions of mechanical engineering projects currently placed in the server have the following structure:

- Application background
- Data acquisition
- Mathematical concepts
- Usage of software
- Openness
- Control of effort
- Identification of sub-tasks
- Links and literature

This structure is related to the quality criteria of mechanical engineering projects stated by the author in (Alpers,2002) and can (but need not) serve as a pattern for defining project classes also in other areas (electrical engineering, business studies, ...) since it is rather general.

Project instances describe specific projects including minor variations. A project instance includes a project description that is handed out to students, as well as materials (if applicable, e.g. a sketch) and a page illustrating results. The latter contains by no means a solution to the project task but it gives an impression of the potential outcome of the project. This is important since the project description is intentionally not too prescriptive since one of the quality criteria is openness. As in real engineering life, the task has to be clarified by group internal discussion as well as communication with the “customer” (here: the instructor). A page called „additional remarks“ describes minor variations of the project task and again serves to facilitate the identification of new projects.

In order to give the instructor a quick overview of a possible solution, a corresponding page and additional documents should be provided. The documents might be project reports, Powerpoint® slide shows or CAS (Computer Algebra System) worksheets produced by students. One can also provide measurement data which the instructor hands out to students if the necessary measurement equipment is not available.

Queries in MAPS

In order to support the search for projects or project classes fulfilling certain criteria, classes as well as instances have searchable attributes. For classes, these are: target group, mathematical topic, application topic. For project instances of which we (wishfully) anticipate to have hundreds there are more attributes in order to offer better search capabilities. These include:

- author, project class, target group
 - mathematical and application prerequisites
 - mathematical and application topics
 - hardware and software required
 - anticipated effort, maximum number of participants
- Using these attributes, instructors can for example
- ask for all projects dealing with spline functions.
 - ask for all projects dealing with motion construction.
 - ask for all projects using a certain kind of equipment (“hardware”), e.g. a milling machine if that is available in the laboratory; or ask for all projects where the hardware entry is “none” if no facilities at all are available.
 - ask for all projects provided by a certain author.

User Interface

When the user wants to search for specific classes, the following screen is offered where mathematical and application topics, target group and description strings can be used as search criteria:

When the user wants to search for specific project instances, the following screen is offered which contains the search criteria stated above:

Example: Audi A2 Door Modeling

If a user searches for all projects belonging to the project class "Reconstruction of geometric objects" s/he gets four project instances. One of these instances is the project "Audi A2 Door Modeling". The user can then ask for the project description as it is handed out to students, for result illustration material in order to get a better idea about the project, and for solution material (password-protected).

For the Audi door modeling project, the task description is the following one:

The surface of one of the front doors of an Audi A2 car is to be measured. For one direction, interpolating spline curves have to be computed, and at the boundary, spline curves should also be computed for the other direction (computation with Maple). The result is to be plotted in Maple. Compute further points on the spline curves and construct an ibl import file for the CAD program Pro-Engineer. Construct a surface in Pro-Engineer and a block having this surface as one of its boundaries. Use Pro-Engineer to produce an NC data file and use this as input for a milling machine.