Generating and verifying variants with Knowledge Fusion and Check-Mate for part modeling examination with NX of undergraduate CAD training at TU Darmstadt

Dipl.-Ing. Michael Maurer
– Research Assistant –
Topics

- University and Department
- CAD Education
- Basic CAD Training
  - Composition
  - Organization
  - Examination
- CAD Training Environment
- Part Modeling Examination
  - Problems
  - Solutions
- Knowledge Fusion
- Check-Mate
Technische Universität Darmstadt

2007 PACE Annual Forum

Faculty of Mechanical Engineering
   One of 16 Faculties at TU Darmstadt
   27 Departments at ME

Datenverarbeitung in der Konstruktion (DiK)
   Department of Computer Integrated Design

Prof. Dr.-Ing. R. Anderl
   Head of Department
   Vice President
   PACE Integrator

Research Assistants at DiK

Presented by: Michael Maurer, TU Darmstadt
CAD Education at TU Darmstadt and DiK

Undergraduate Level (Bachelor of Science)

Lecture “Introduction to CAD”

Basic CAD training

Handskeetching, Part and Assembly Modeling, Drafting

Lecture “Fundamentals of CAE / CAD”

CAx Process Chains (Part & Assembly, CAD-FEA, CAD-NC)

Graduate Level (Master of Science)

Tutorial “Advanced CAx”

Freeform Shaping, CAD-FEA, Multibodysimulation

Advanced Design Project “Collaborative Engineering”

Project Collaboration with Virginia Tech and Howard University (USA), ITESM Monterrey (Mexico) and SJTU (Shanghai)

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Basic CAD training – Composition

- **Lecture**: 2 hrs./week
- **Exams**: 5 different exams
- **Trainings**:
  - Supervised: 3 hrs./week
  - Self-practice: up to 6 hrs./week

**Summer class 2010**: NX 7 and Teamcenter 8.1 UA

**Presented by**: Michael Maurer, TU Darmstadt
Basic CAD training – Organization

Responsible Supervisor Board

1-2 Research Assistants

Tutor

55 Tutors

Tutor

850 Students

Team 1
6 Students
Team 2
6 Students
Team 3
6 Students

Team 4
6 Students
Team 5
6 Students
Team 6
6 Students
Basic CAD training – Examination

- Handsketching
  - Block

- Part Modeling
  - Shaft
  - Block

- Assembly Modeling
  - Helicopter (Teamwork)
  - Theory Exam

- Technical Product Documentation
  - Single part Drawing
  - Assembly Drawing
  - Hand Drawing

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CAD Training Environment

To provide product data, project administration and workflow processes, we use:

- **Over 120 MS Windows® workstations**
- **TC Two-Tier architecture**
  - Resource Tier
    - TC Database Server
    - TC File Server
  - Client Tier
    - TC Rich Clients

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Part Modeling Examination – Problem

- Existing of 24 different NX parts for over 800 students
- Every student gets 2 of them for Analysis and Re-Modeling
- Not enough parts → Students share solutions
- Level of difficulty (construction steps and severity) is different
- Some functions weren’t requested to pass the exam
- Correction through tutors takes lot of time → no automatism

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Part Modeling Examination – Solution

Not enough parts → Students share solutions
  – Provide a variety of different NX parts via Knowledge Fusion (KF)

Level of difficulty (construction steps and severity) is different
  – Every feature was rated and got a scale factor
  – Summarizing over scale factor per part → nearly same level of difficulty

Some functions weren’t requested to pass the exam
  – Two different types of parts: Shaft and Block

Correction through tutors takes lot of time → no automatism
  – Semi-automatically correction via Check-Mate

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Knowledge Fusion

- Knowledge Based Engineering tool of NX
  - Connections with object oriented database or table of links to the CAD model

- Geometric objects exist as classes in KF
  - They can be created, changed and connected by their attributes
  - Existing geometry elements can be imported and edited

- Classes are available for
  - handling of parts and assembly files
  - database or table links connectivity
  - integration of results from external programs

- With the help of rules and constraints, it is possible to create complex product models and flexible parametric CAD models

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Realization – Building variants

Shaft
variant-based as series design

Block
modular construction system

Presented by: Michael Maurer, TU Darmstadt
# Realization - Spreadsheet

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Klotz=Block; Welle=Shaft

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Realization – Knowledge Fusion

pa1_part1

loop_create_part

create_part

content_part1

groove

slot

notch

...
Check-Mate

• **Knowledge validation tool**
  – Allows quality assurance of individual parts, assemblies and drawings

• **Based on the language of Intent!® as well as Knowledge Fusion**
  – Classes and functions of *KF* can be used by *Check-Mate*

• **With the available checkers in NX it can be tested on e.g.**
  – surfaces or volumes
  – distances between points or/and lines
  – repressed or hidden features
  – review of sketches to full determination

• **Checkers can be edited or be written new**
Using Check-Mate

Checkers to monitor if geometric details are right or wrong

Information checkers
Summary

- CAD education at TU Darmstadt – Faculty of Mechanical Engineering
  - Composition – Organization – Examination

- Infrastructure of the CAD training environment

- Part modeling Examination
  - Problems and solutions

- Knowledge Fusion
  - Realization and building variants

- Check-Mate
Thank you!

Dipl.-Ing. Michael Maurer
– Research Assistant –

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Department of Computer Integrated Design

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CAD Online-Tutorial: http://nx2010.iim.maschinenbau.tu-darmstadt.de/