Internship report

CADFEM

Munich, Stuttgart, Hannover

MT15-03M Smirnov Alexander
Scientific supervisor: PhD in engineering science Iptyshev A.A.

11.10.2016
My research

• **Speciality:** Automation of design-technology engineering

• **Subject matter:** Automation of spur gear profiles preprocessing used in CAM-software

11.10.2016
Internship objectives

• To learn the possibilities of automation in calculations by means of ANSYS system
• To train on innovative program modules development within the framework of ANSYS system
CADFEM
CADFEM – CAE simulations since 1985

CADFEM in D, A, CH
• 60 million euros of revenue
• 2,300 customers
• 12 locations
• 185 employees (worldwide >250)
• Family-run business

CADFEM and ANSYS partnership
• Since company's foundation
• Offering all ANSYS products
• Close technical collaboration
• CADFEM: Competence Center FEM
• ANSYS Germany: Competence Center
First week

Structural Mechanics with ANSYS Mechanical, Topology Optimization

**ANSYS Workbench / Software handling**
- Introduction to FEM
- Demonstrator (live)
- Workbench Project page
- Material Definition
- Objects and their properties
- Coordinate Systems
- Mechanical software handling
- Named Selection Worksheet

**Discretization / Theory**
- Meshing (Theoretical Introduction)
- Element size of thin Structures
- Geometry Preparation
- Global Mesh Settings
- Local Mesh Settings
- Mesh based simplification
- Connecting bodies

**Boundary Conditions / FE Idealization**
- Introduction to Boundary Conditions
- Deformation-Boundary Conditions
- Remote Points
- Nodal Coordinate Systems
- Introduction to Nonlinear Statics
- Load-Boundary Conditions
- Inertial Loads
- Nonlinear Boundary Conditions-Contact

**Evaluation of Results**
- Evaluation of Results
- Adaptive Mesh Refinement
- Singularities
- Evaluation in Cylindrical Coordinates
- Construction Geometry - Path Evaluation
- Probes
- Submodeling
- Computation of large Models (HPC)

- Module 1: Material along the load paths
  - Motivation
  - Concept of the topology optimization
  - ACT Extension
  - 2D michell-structure (Hands-on)

- Module 2: Without restrictions it will not work
  - Design constraints
  - Manufacturing constraints
  - Generic engine mount (Hands-on)

- Module 3: Different ways to get the optimal design
  - Objective functions
  - Comparison of different objectives (Hands-on)
  - Single Compliance vs. Multiple Compliance (Hands-on)

- Module 4: Redesigning
  - ANSYS Topology Optimization → ANSYS SpaceClaim (Hands-on)
Second week
Customization with ACT, High Performance Computing (HPC)

First day
- Introduction ACT
- (Iron)Python
- XML format
- Toolbar
- Journaling (project schematic)

Second day
- ACT console
- Change and insert standard features
- Pre-processing feature (reuse APDL)
- Post-processing feature
- Graphic
- Create report

Third day
- Exercise: fix displacement
- Compiling an extension
- Wizard
- Libraries
- Optional topics
- DesignModeler
- Insert meshfeature
- Rename by class
- Debugging with Visual Studio

Day 1 – Modelling techniques
1. Purpose
2. Submodelling and External Data
3. Substructuring, CMS

Day 2 – High Performance Computing
1. Solvers (structural, thermal, Eigen-)
2. Components and aspects of HPC
3. „Do …“ and „Don’t …, if you can do it in another way“

11.10.2016
## Third week

Contact Modeling with ANSYS Mechanical

### Day 1
- 2.) Illustrative Introduction
- 3.) Connection Groups
- 4.) Contacts between Surface Bodies
- 5.) Analysis Settings
- 6.) Input and Output Files
- 7.) Contact vs. Target
- 8.) Force Control vs. Displacement Control
- 9.) Evaluation of Results
- 11.) Trim Contact

### Day 2
- 10.) Contact Elements

### Day 3
- 12.) Types of Contact
- 13.) Detection Method
- 14.) Pinball-Region
- 15.) Contact Algorithm
- 16.) Contact Stiffness
- 17.) Penetrations
- 18.) Bending Example
- 19.) Rigid Body Motions
- 20.) Bonded Contact
- 21.) Contact Treatment
- 22.) Convergence Treatment

11.10.2016
Conclusions

• Pros
  – Calculation of products durability
  – Launch of automatic parametrical simulations
  – Automation of ANSYS simulations by means of ACT

• Cons
  – Dynamic simulations classes were not available