PERMAS4EDU

PERMAS for Education

PERMAS Web Conference 2020

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INTES GmbH

Contents

1. **Introduction**
   - What is PERMAS for Education?
   - Content of EDU Edition
   - Limits, Rules, Basics
2. How to get the EDU Edition?
   - Registration, Download, Installation, Manuals, Forum, First Usage
3. Demonstration
   - PERMASCC, PERMAS, VisPER, Wizards
     - PERMAS*4EDU* Tutorial with Meshing (Movie)
     - Topology Optimization
     - Contact Analysis

Introduction

- What is PERMAS for Education?
  - Essentially the same functionality as PERMAS, but some limitations to prevent commercial use.
  - VisPER → GUI to PERMAS, Pre- and Postprocessor
- Benefits
  - Available on Windows and Linux
  - Based on Version 18
  - Almost all modules are available
  - Ideal for self-study and further training
  - Access to Reference Manuals
  - Access to a multitude of application examples
  - Trying out new modules, e.g. TOPOlogy optimization and Shape OPTimization
  - Interfaces to Abaqus and NASTRAN for a seamless transition to PERMAS
  - Enhanced Python Interpreter → pyINTES
  - User Forums hosted at INTES and Researchgate for the exchange with other users

Limitations

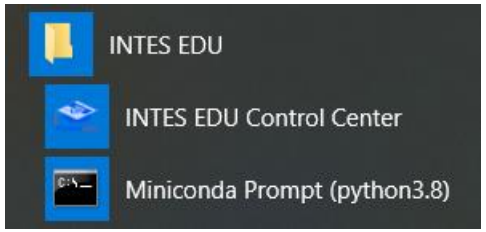
- Max. Number of Nodes: ~16K
- Max. Number of DOFs: ~65K
- Max. Number of Elements: ~32K
- Max. Number of point/line elements (e.g. BECOS, SPRING, MASS): 100

- Max. Number of Excitation Frequencies: 500
- Max. Number of Time Steps: 1000
- Max. Number of Load Cases: 1000
- Max. Number of Nonlinear Results Steps: 100

pyINTES

- Python has become the programming language of choice for certain research and industry projects
- We are aware of this development and offer an own Python environment
- UCI USER section
  - CALL TOOL6 P1 = ‘pyINTES <myscript.py> …’
- Examples
  - EMA1 – Experimental Modal Analysis MAC matrix visualization, Excel export
  - MNL17 – Fiber Reinforced Wheel

- numpy
- scipy
- sympy
- Matplotlib
- scikit-image
- mplcursors
- meshio
- numpy-stl
- python-pptx
- python-docx
- Xlsxwriter
- … many more



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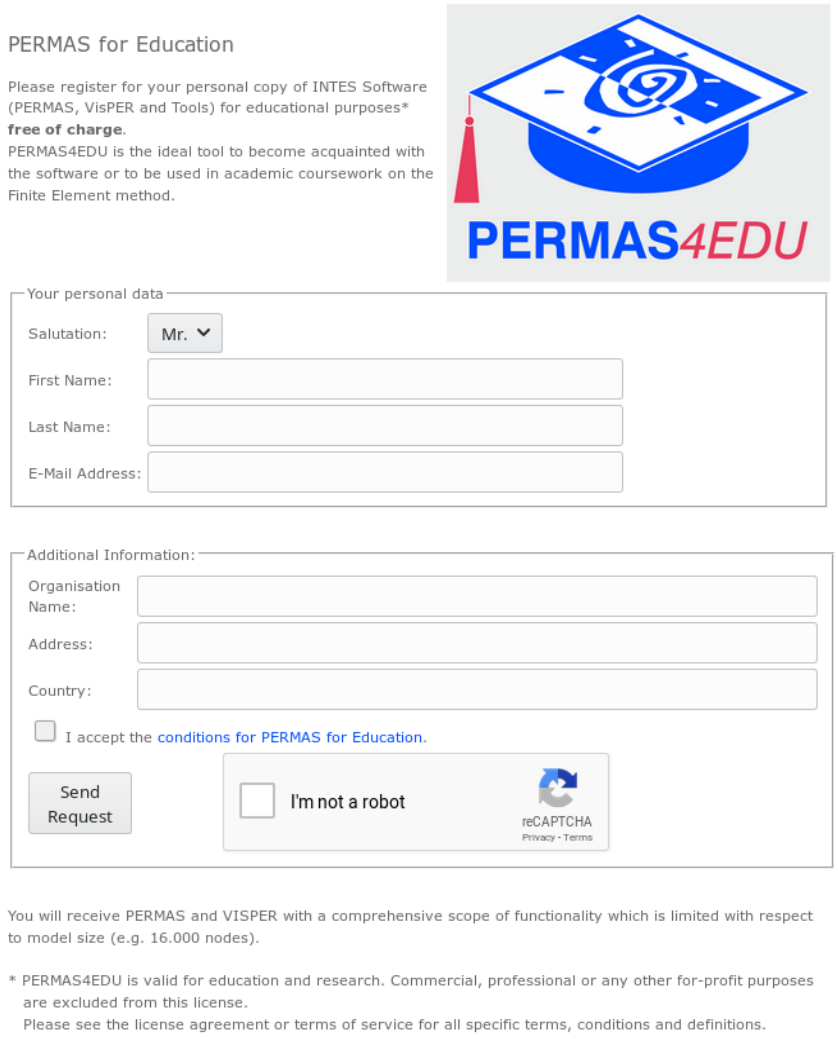
Registration Process

www.intes.de/EDU

- Activate the checkbox, i.e. accept the conditions for PERMAS4EDU
- EULA is available in pdf format
- Activate the checkbox *I'm not a robot*
- Push the ***Send Request*** button
- Instructions by E-Mail how to proceed
- A link to the user forum



Mandatory
- First Name
- Last Name
- Valid E-Mail address

Optional
- Organization
- Address
- Country

Requirements on Windows

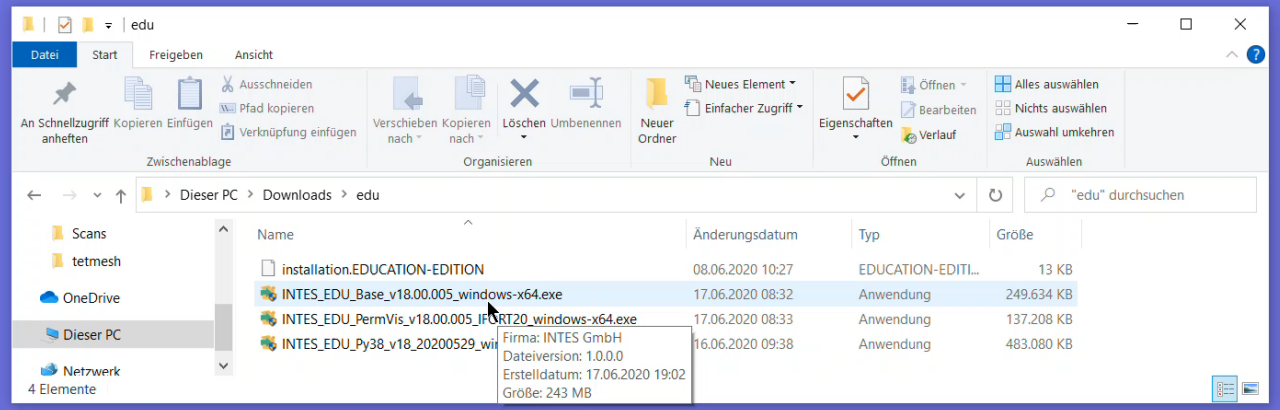
- Target CPU: INTEL EM64t/I64 or AMD Opteron / Athlon 64
- 64-bit
- Build OS: Windows 10
- Target OS: Windows 10
- Memory Limit: 8000 MB
- Required Windows packages:
  - pdf viewer e.g. foxit, sumatra, acrobat reader DC
- Optional : INTEL Fortran Compiler

Download & Installation on Windows

- According to the received E-mail download the 3 Windows installers, i.e.
  - INTES_EDU_Base_v18.00.NNN_windows-x64.exe (244 MB)
  - INTES_EDU_Py38_v18_YYYYMMDD_windows-x64.exe (472MB)
  - INTES_EDU_PermVis_v18.00.NNN_IFORT20_windows-x64.exe (134MB)
- Copy the received license file to the directory containing the downloaded installers.
- Now run the Base installer and follow the instructions, i.e.
  - INTES_EDU_Base_v18.00.NNN_windows-x64.exe
- Launch intesedu
  - Click on the PERMAS4EDU icon

Entire Installation Process on Windows

- Real time installation process
- Base Installer
- License agreement (00:13)
- Installation directory
- Scratch directory for database (quick access time, i.e. SSD)
- License agreement Miniconda (01:48)
- Installing PERMAS/VisPER EDU binaries (6:40)
- Installation finished (7:20)



Requirements on Linux

- Target CPU: INTEL EM64t/I64 or AMD Opteron / Athlon 64
- 64-bit
- Build OS: CentOS 7
- Target OS: **64-bit** Linux with GNU 8 compiler suite
  - glibc 2.18 and gfortran/gcc/g++ 8 based
- Memory Limit: 8000 MB
- Required Linux packages: zlib-devel, gfortran, g++, gcc, pdf viewer, e.g.okular, qpdfview, envince, xpdf

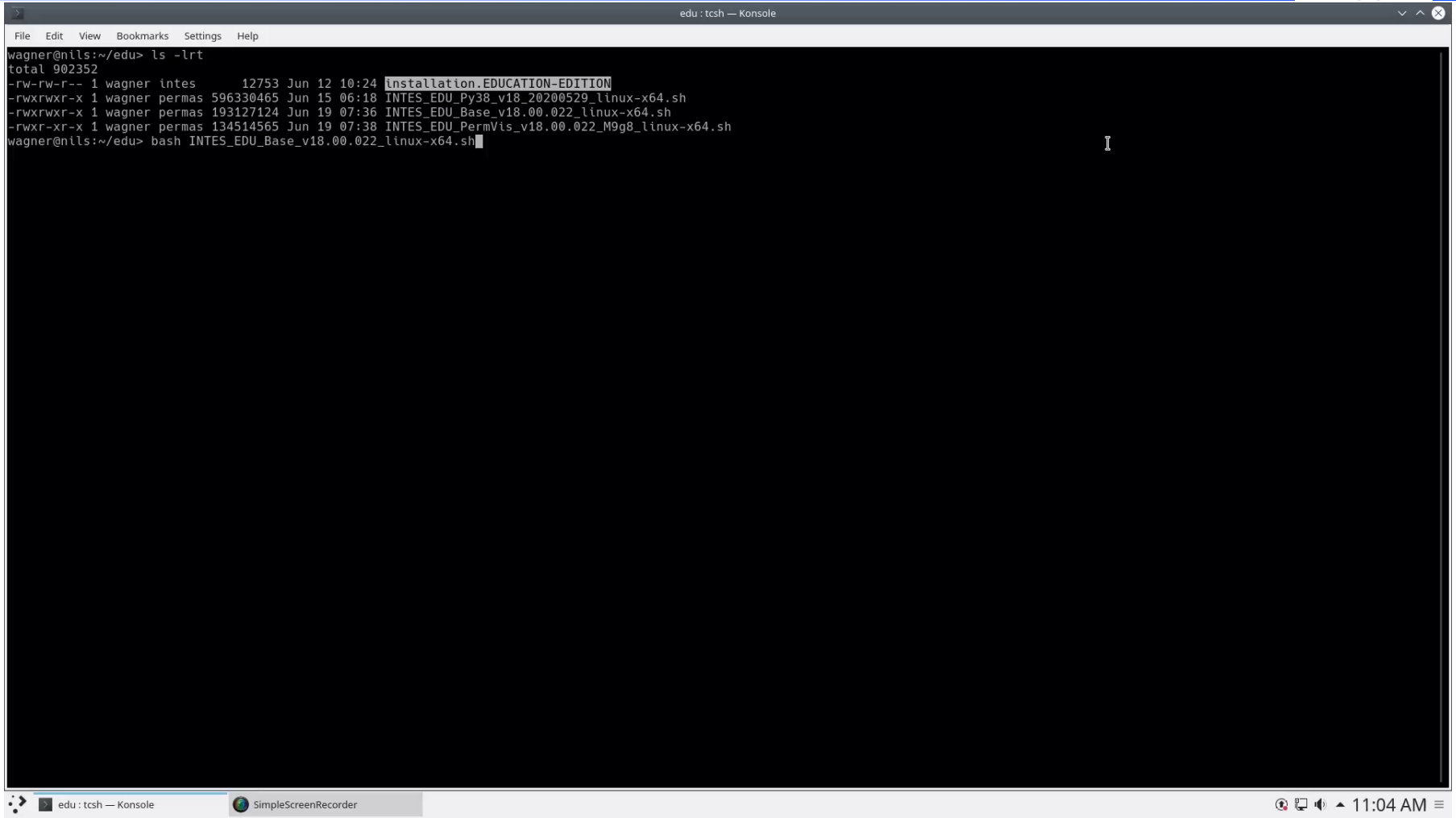
Download & Installation on Linux

- According to the received E-mail download the 3 Linux installers, i.e.
  - INTES_EDU_Base_v18.00.NNN_linux-x64.sh (185MB)
  - INTES_EDU_Py38_v18_YYYYMMDD_linux-x64.sh (569 MB)
  - INTES_EDU_PermVis_v18.00.NNN_M9g8_linux-x64.sh (129 MB)
- Copy the received license file to the directory containing the downloaded installers.
- Now run all 3 installers, beginning with the Base installer and follow the instructions, i.e.
  - bash INTES_EDU_Base_v18.00.NNN_linux-x64.sh
  - bash INTES_EDU_Py38_v18_YYYYMMDD_linux-x64.sh
  - bash INTES_EDU_PermVis_v18.00.NNN_M9g8_linux-x64.sh

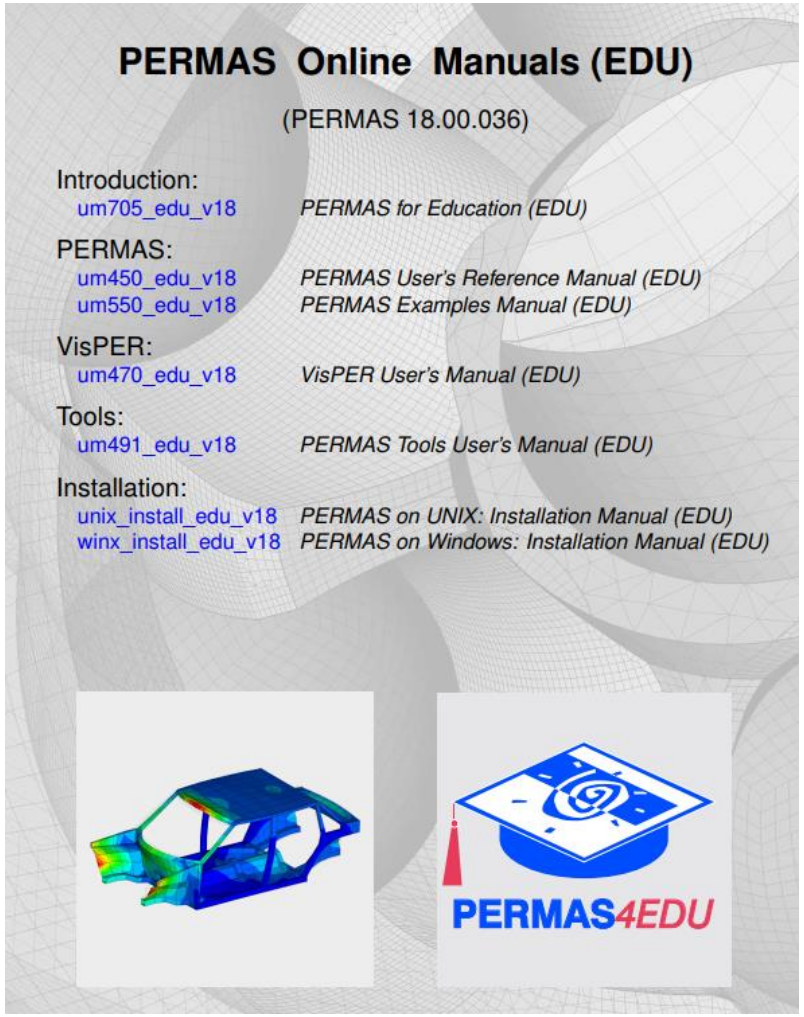
Entire Installation Process on Linux

Installation Directory

- Absolute path is needed, e.g. /home/edu/intesEDU
- Absolute path is needed for the license file



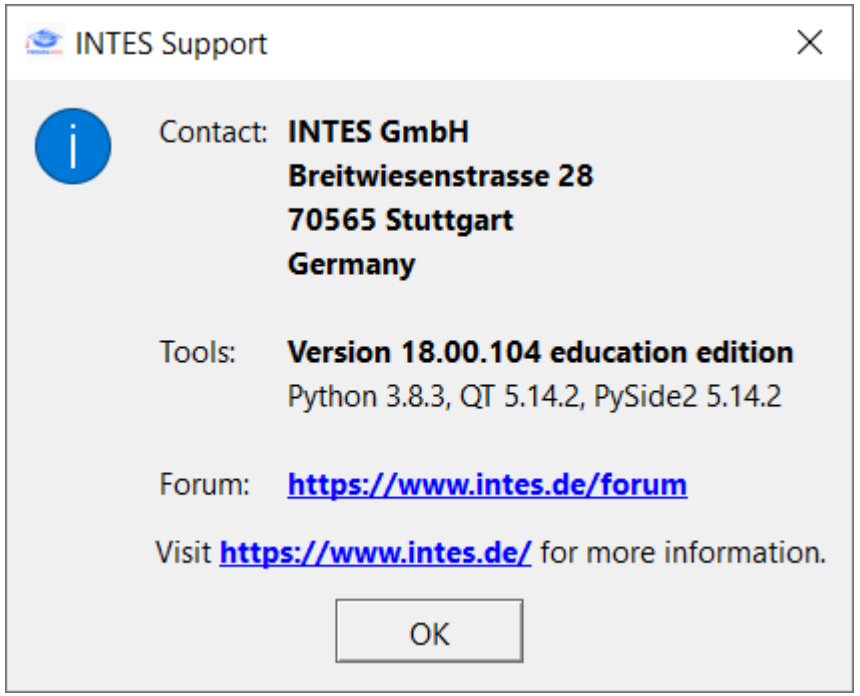
Manuals

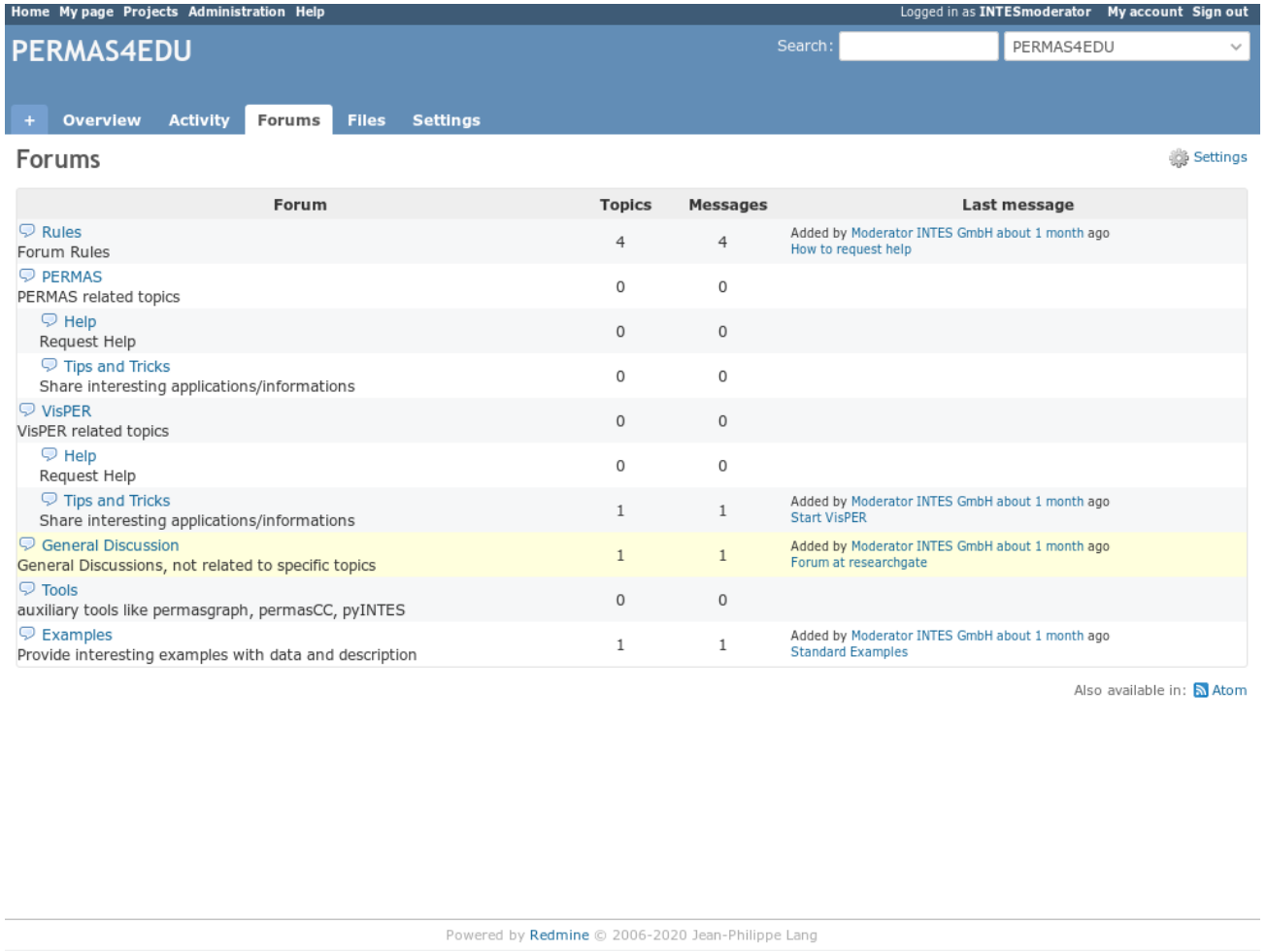


- PERMAS for Education UM705_EDU_V18
- PERMAS User's Reference Manual UM450_EDU_V18
- PERMAS Example's Manual UM550_EDU_V18
- VisPER User's Manual UM470_EDU_V18
- PERMAS Tools User's Manual UM491_EDU_V18
- PERMAS on Unix: Installation Manual
- PERMAS on Windows: Installation Manual

Forum

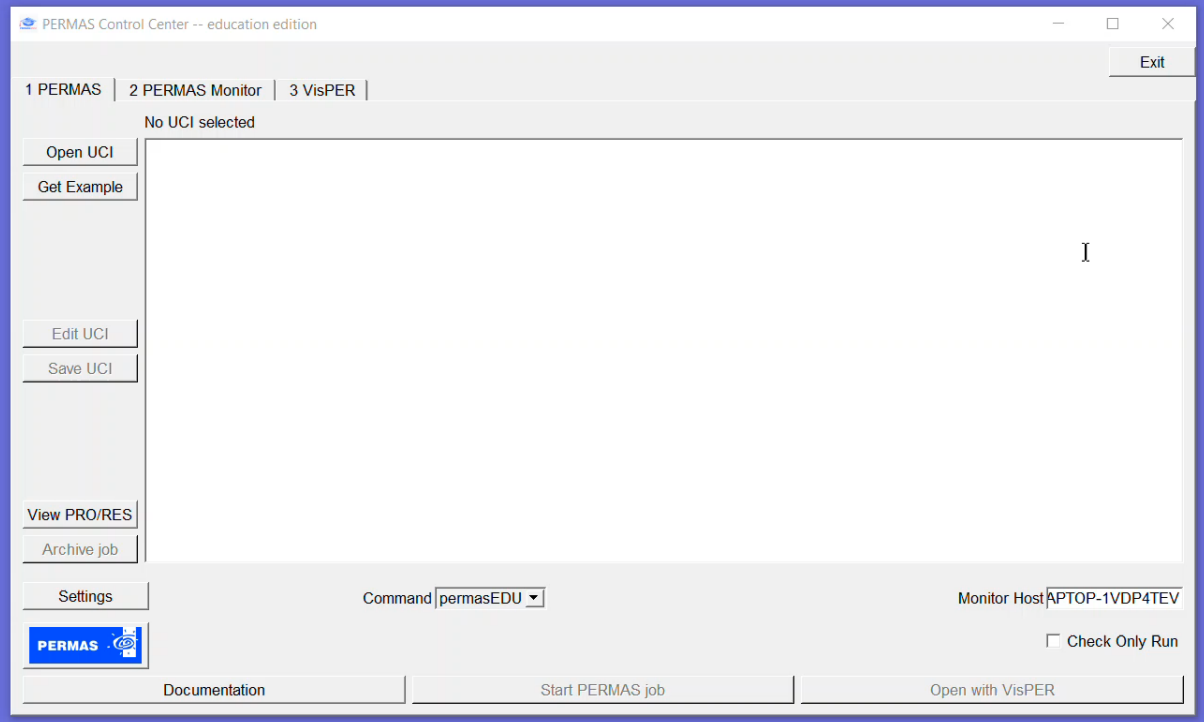
- Exchange with other users
- https://www.intes.de/forum
- https://www.researchgate.net/topic/PERMAS
- Hotline support is not available for EDU users





First Usage

- PERMAS Control Center
- Settings
- Emacs Gold for *.dat VisPER Tab PERMASCC(Edit)
- **Code handling**: automatic Highlighting using the Pygments highlighter
- Direct access to manuals
- Get Example
  - Linear Statics LS1
  - Edit UCI (F1 button)
  - Start PERMAS Job
  - Open with VisPER



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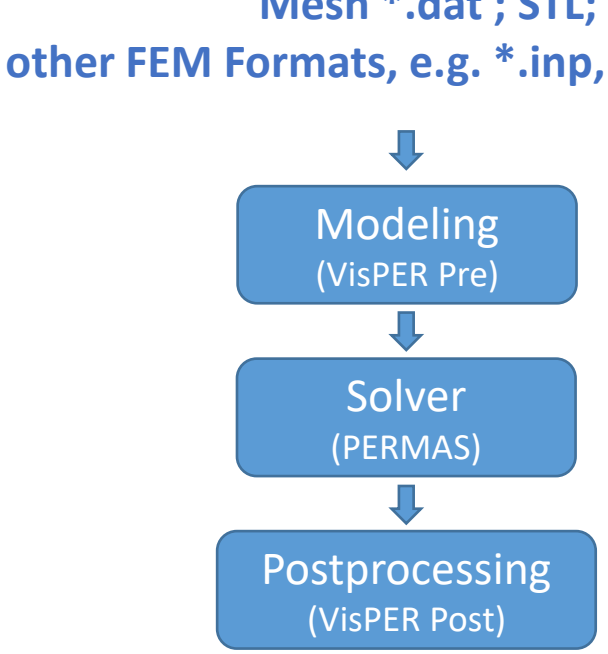
     - Contact Analysis

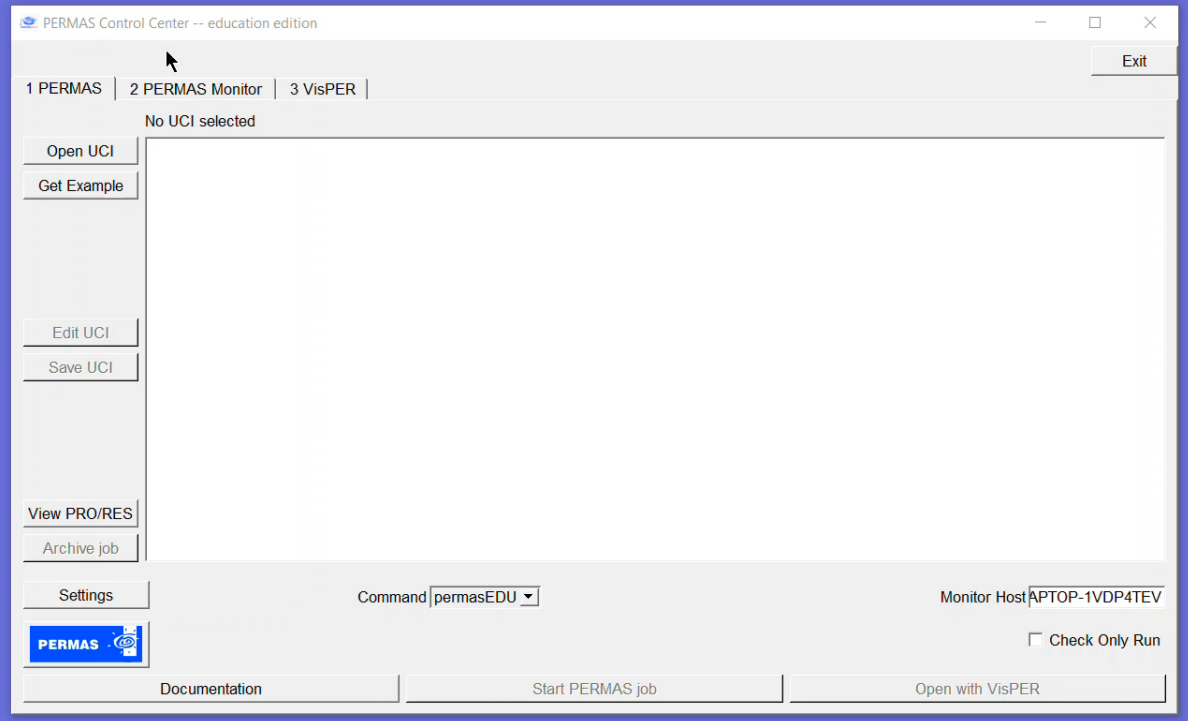
Handling of STL Files in VisPER

- Raw, unstructured triangulated surface
- Support of ASCII format
- Binary format can be converted to ASCII format by using numpy-stl (Part of pyINTES)
- Direct import in VisPER
- Alternatively, READ STL FILE = geom1.stl within INPUT section of *.uci
- Remeshing is usually necessary due to poor element quality
- Volume meshing is supported in VisPER by an interface to netgen



Patch Meshing & Design Wizard

- VisPER tutorial: edu1
- Element quality PLOTA3
- PatchMeshing Tool
- Average Edge length: 5mm
- Edges are retained during remeshing
- Check element quality again
- Design Wizard
- Create Tet Mesh
- Check element quality TET4
- Export New Items



TOPO+LS+BA Model Description

Objective function

- WEIGHT

$$m = \int \rho \, \mathrm{d}V = \sum_{i=1}^{n} \rho_i V_i \qquad (1)$$

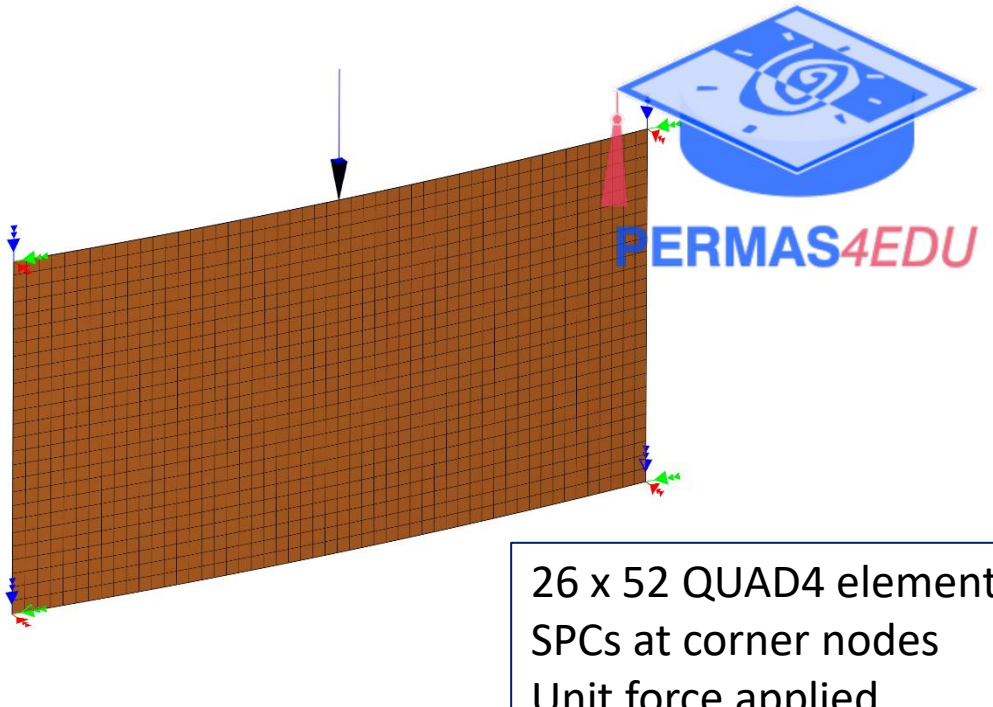
Two Constraints

- STATIC

$$\boldsymbol{K}\boldsymbol{u} = \boldsymbol{f}, \quad \boldsymbol{c}^{\mathrm{T}}\boldsymbol{u} \geq \underline{u}_i \qquad (2)$$

- BUCKLING ANALYSIS MODES = 1 SIGN = POSITIVE

$$\boldsymbol{K}_g(\boldsymbol{\sigma})\,\boldsymbol{x} = \lambda \boldsymbol{K}\,\boldsymbol{x}, \quad s = -\frac{1}{\lambda}, \quad s \geq \underline{s} \qquad (3)$$



26 x 52 QUAD4 elements
SPCs at corner nodes
Unit force applied
Material: Aluminum
R = 3000 mm
h = 260 mm
s = 520 mm
t = 2 mm

https://iopscience.iop.org/article/10.1088/1757-899X/531/1/012082

Topology Optimization

PERMAS is controlled by a stream of commands submitted by the User Control Interface (UCI)

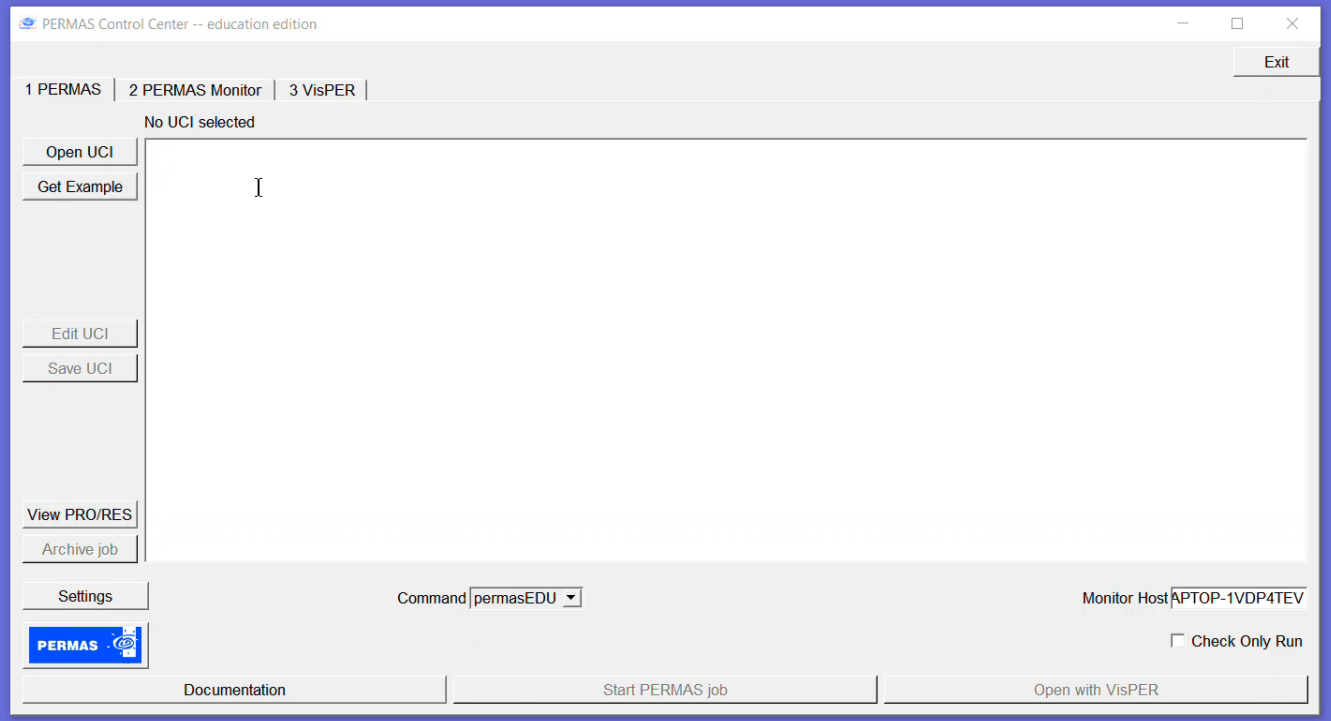
```
! See PERMAS Examples manual "um550.pdf" for more informations.
!
! REQUEST.MODULES =  BA; LS; MQA; TOPO
!
NEW
INPUT
    READ PERMAS FILE = topo13_model.dat
    READ PERMAS FILE = topo13_topo.dat
RETURN
TASK LOOPS = 80
EXEC
    ACT SIT = STATIC
    STATIC
    ACT SIT = BUCKLING
    BUCKLING ANALYSIS MODES = 1 SIGN = POSITIVE
    ACT SIT = TOPO
    TOPO METHOD = ACP
EXPORT
    ITEM CLEAR
    ITEM EFRATIO
    GO PERMAS BINARY FILE = topo13_efratio
TASK END
EXPORT
    ITEM CLEAR
    ITEM EFRATIO
    GO PERMAS BINARY FILE = topo13_efratio
EXPORT
    ITEM CLEAR
    ITEM XYDATA TYPE = SRHIS
    GO PERMAS ASCII FILE = topo13_tracking
    ITEM CLEAR
    ITEM XYDATA TYPE = OHIS
    ITEM XYDATA TYPE = CHIS
    ITEM XYDATA TYPE = RHIS
    GO PERMAS ASCII FILE = topo13_histories
    ACT SIT = BUCKLING
     GO PERMAS FILE = topo13_modes
STOP
```

- Subsequent Steps in 3 Videos
  - PERMAS Control Center
  - How to get examples
  - Model completion
  - Export New Items
  - Launch modified TOPO13
  - Postprocessing of TOPO results
    - xy-data by PERMASGraph
    - Objective Function HIStory
    - Relative Constraint HIStory (Possible violations?)
    - Evolution of Element Filling RATIOs by VisPER
    - Derive Data → Data Combination → ITEM EFRATIO

Model Completion by Wizards

- Wizard concept in VisPER
- User-friendly, guided way to create additional data
- Machine generated data
- Less error prone

- TOPO Situation
- Design element
- Initial filling ratio
- Lower and Upper Bounds
- Exponent for SIMP method
- Manufacturing Conditions
- Design variable filter
- Constraints
- Optimization Target
- Export New Items

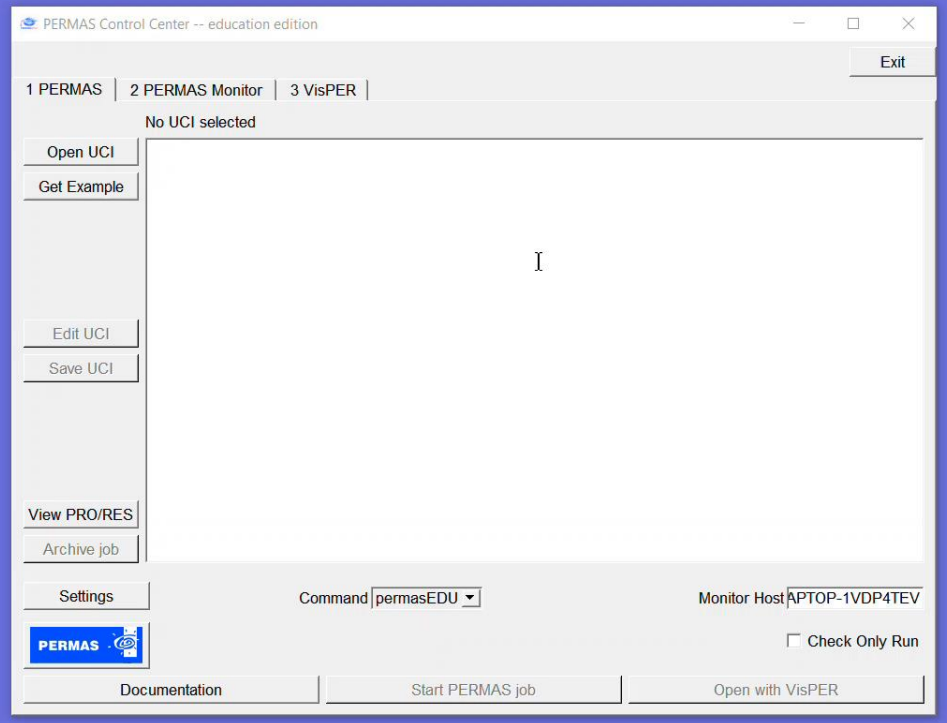


SIMP : Solid Isotropic Material with Penalisation

PERMAS Control Center

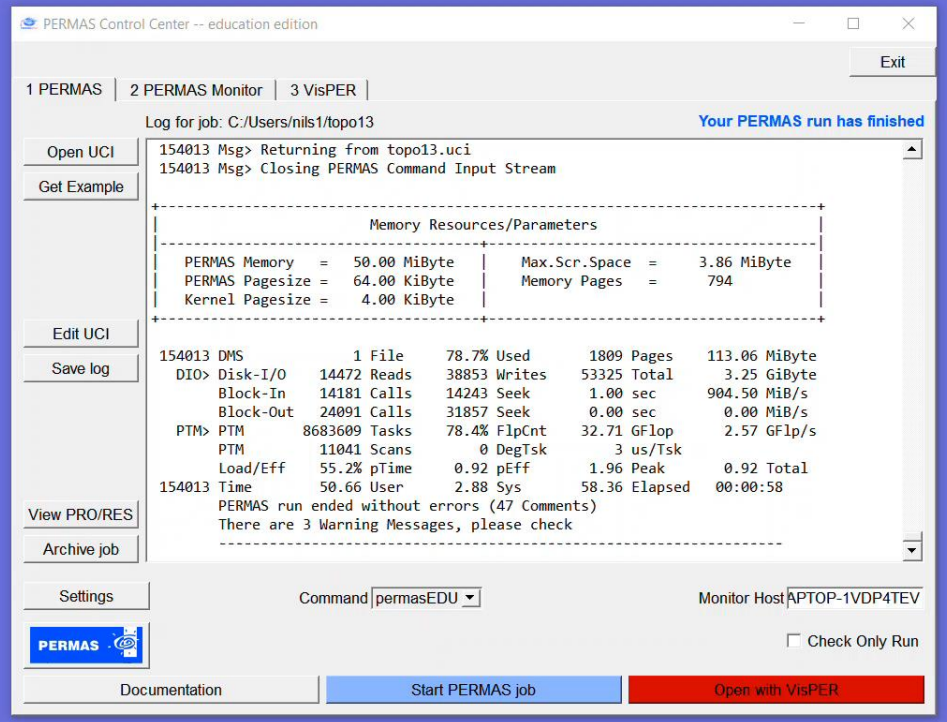
Run TOPO13

- PERMAS CC
- Get Example TOPO13
- Edit UCI
- New Export section within TASK LOOP for intermediate results
- Run TOPO13
- Logfile output



Post-Processing of TOPO Results

- Postprocessing
- Import of selected results
- Permasgraph for xy-data
- Interpreting results
- VisPER
- Derive data
- Data combination
- Animation

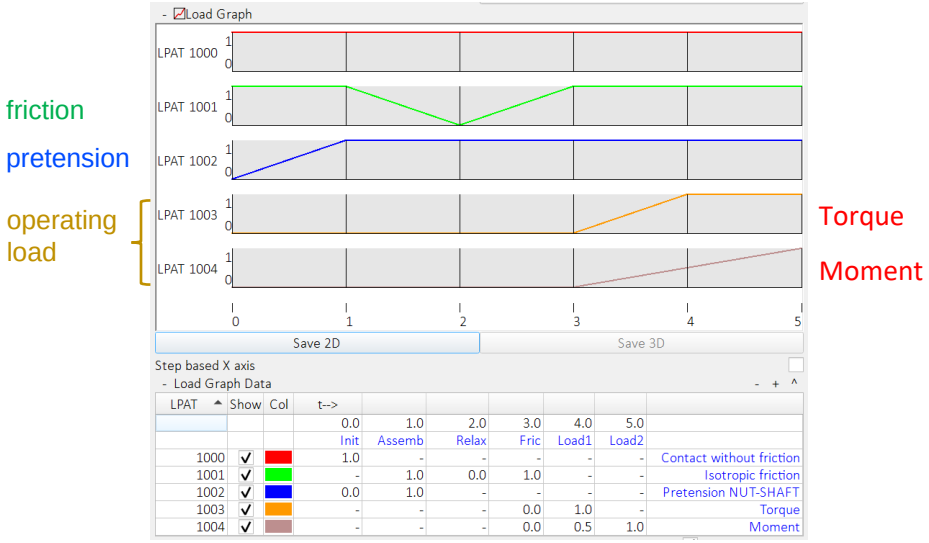


Q&A

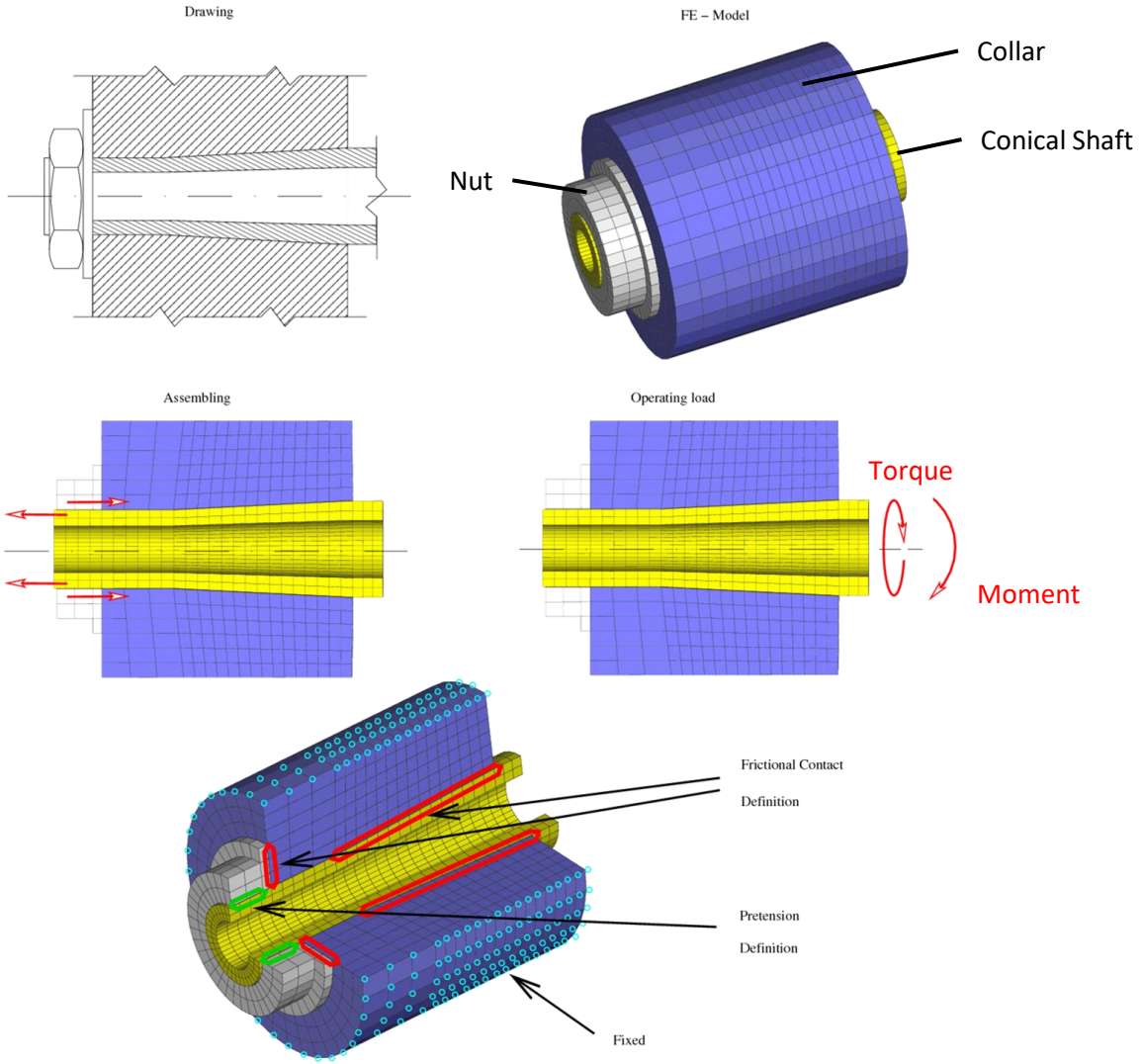
- Many thanks to my colleagues from the development department. Without them PERMAS4EDU wouldn’t exist.
- Feedback is welcome!
- Are you curious to use PERMAS4EDU?
- Don’t hesitate to contact us at any time → info@intes.de
- Follow our YouTube Channel
- Follow us on LinkedIn

Demo: Contact Analysis

- Based on example CA6
  - Pretension Wizard
  - CA-Wizard: CA-Check
  - Load History-Assistant: Editing
  - Postprocessing: Displacement, CA-Results



LPAT	Show	Col	t-->						
			0.0	1.0	2.0	3.0	4.0	5.0	
			Init	Assemb	Relax	Fric	Load1	Load2	
1000	☑		1.0	-	-	-	-	-	Contact without friction
1001	☑		-	1.0	0.0	1.0	-	-	Isotropic friction
1002	☑		0.0	1.0	-	-	-	-	Pretension NUT-SHAFT
1003	☑		-	-	-	0.0	1.0	-	Torque
1004	☑		-	-	-	0.0	0.5	1.0	Moment



Summary

PERMAS*4EDU*

- Essentially the same functionality as PERMAS/VisPER
- Ideal for self-study and further training
- User Forums available
- Complete solution from mesh to postprocessing

- Free for noncommercial use
- Registration necessary: www.intes.de/EDU

- Available July 02, 2020 (tomorrow)

Thank You!

- Feel free to ask!
- Do you need more information about PERMAS: info@intes.de