Making PERMAS model assembly effective by *VisPER*

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Overview

- Motivation and Target
- Process: Model Assembly
- Example Structure: Differential
- 1. Add Missing Shaft
- 2. Replace Initial Shaft by New Design
- 3. Replace Initial Case by New Design
- Conclusion

Motivation

- Ongoing pressure to accelerate development processes.
- Model assembly is a bottle neck in FEM modeling.
- PERMAS is a tool for FEM specialists: FEM model complexity is high.
- High number of model variants during development is very typical.
- Replacement of model part to create new variant of assembly is time consuming (working time).

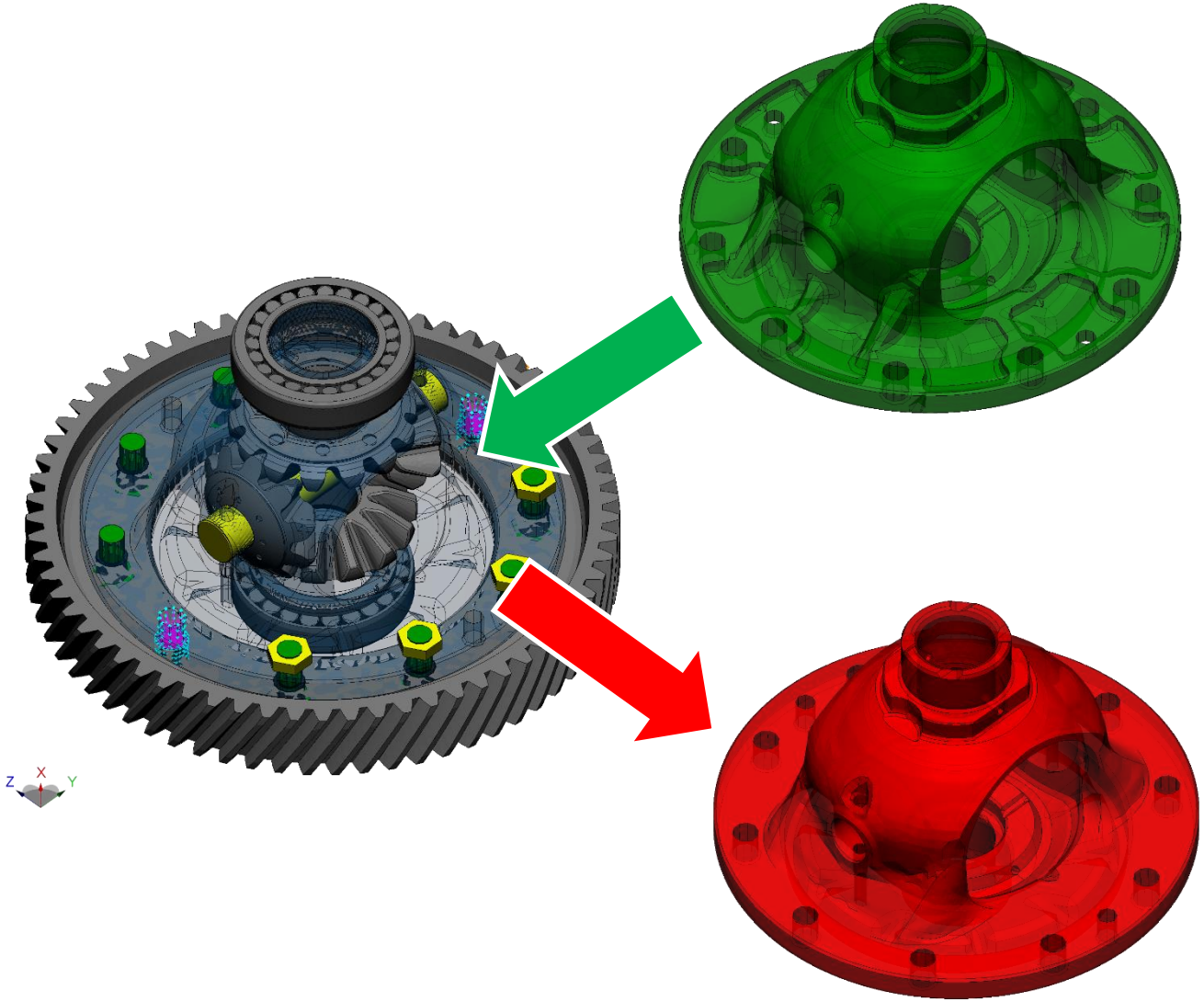
➢Better assembly solutions for complex FEM models demanded!

Motivation + Target

- Acceleration of
  - complex (error-prone),
  - Frequent, and
  - manual

  processes of model assembly.

- Save
  - working time,
  - man power,
  - Attempts, and
  - money!



Process: Model Assembly

- ***VisPER*** has finished his “start-up” phase, considerable physical modeling functionality is available.
- Several Wizards for simplification of complex inputs are available.
- Next step: New level for basic modeling functionality.
- First: Model Assembly!
- Requirements:
  - Acceleration of process
  - Recover of existent coupling
  - Replace slow manual error prone process with a guided semi automatic fail safe fast process driven by user with visual feedback
  - Cover complexity of todays models (assemblies)
  - Ensure a consistent model

Highlights of Existing *VisPER* Assembly Technology

- File → Export → New Items [Clear new items after export]
  - clever separation of new created items in new file
  - + original model remains unchanged
  - + stepswise, with the option to clear the buffer
  - - only additive
- File → Export → Selected Items
  - systematic export of items
  - + free separation of parts, variants, situations, materials, …
- Relabeling for elements, nodes and local systems
- Referencing – presents data dependencies in a tree view
- Selection methods – complete, fast and with least clicks

Missing Preprozessing Features

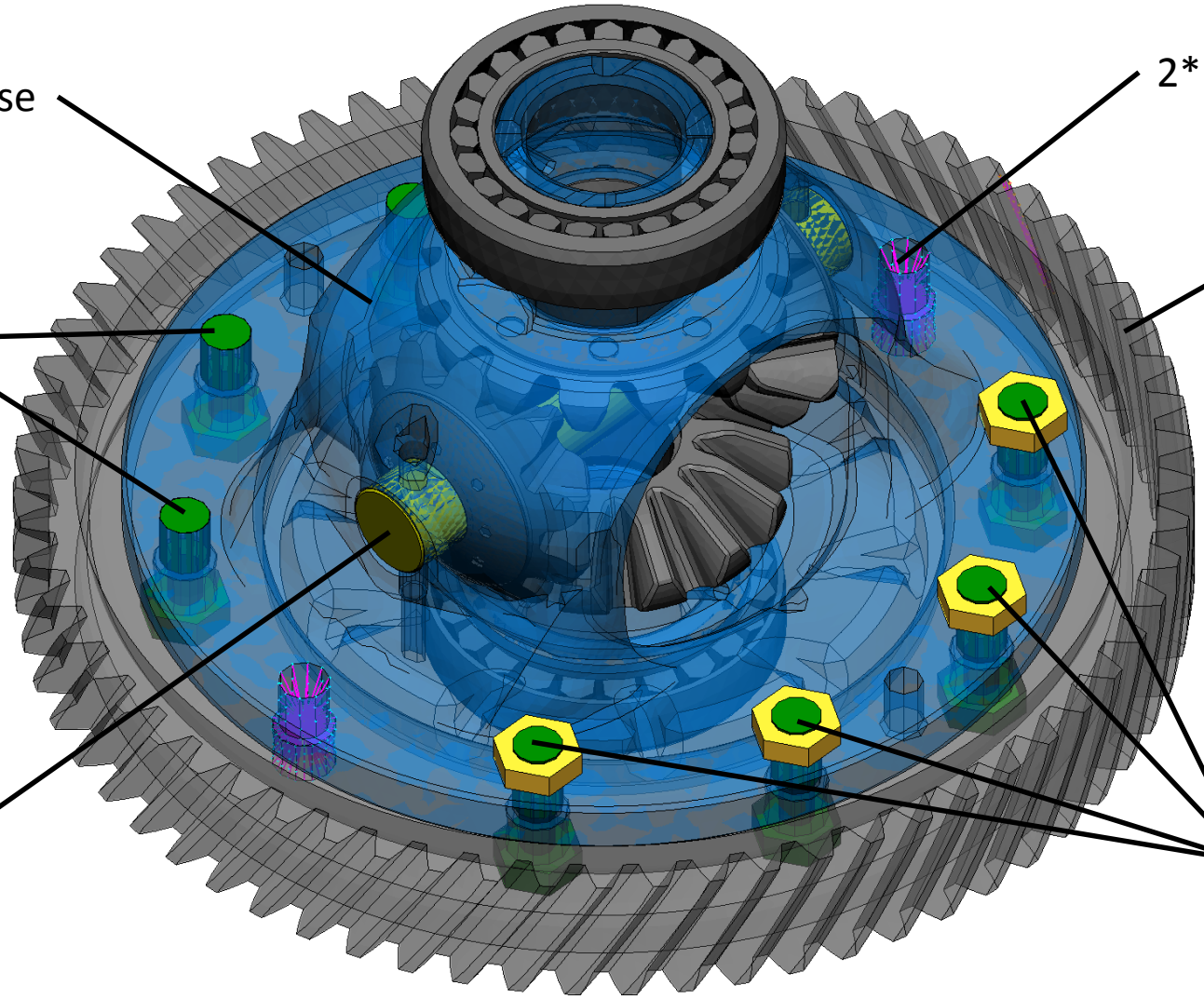
Missing general features in ***VisPER*** up to V5 that we have added now:

- Positioning (so far in SubWizard)
- Multi Read

New unique features are required to lift functionality to new level:

- Assembly process integration
- Re-use of physical coupling
- Reconnect
- Keep model integrity

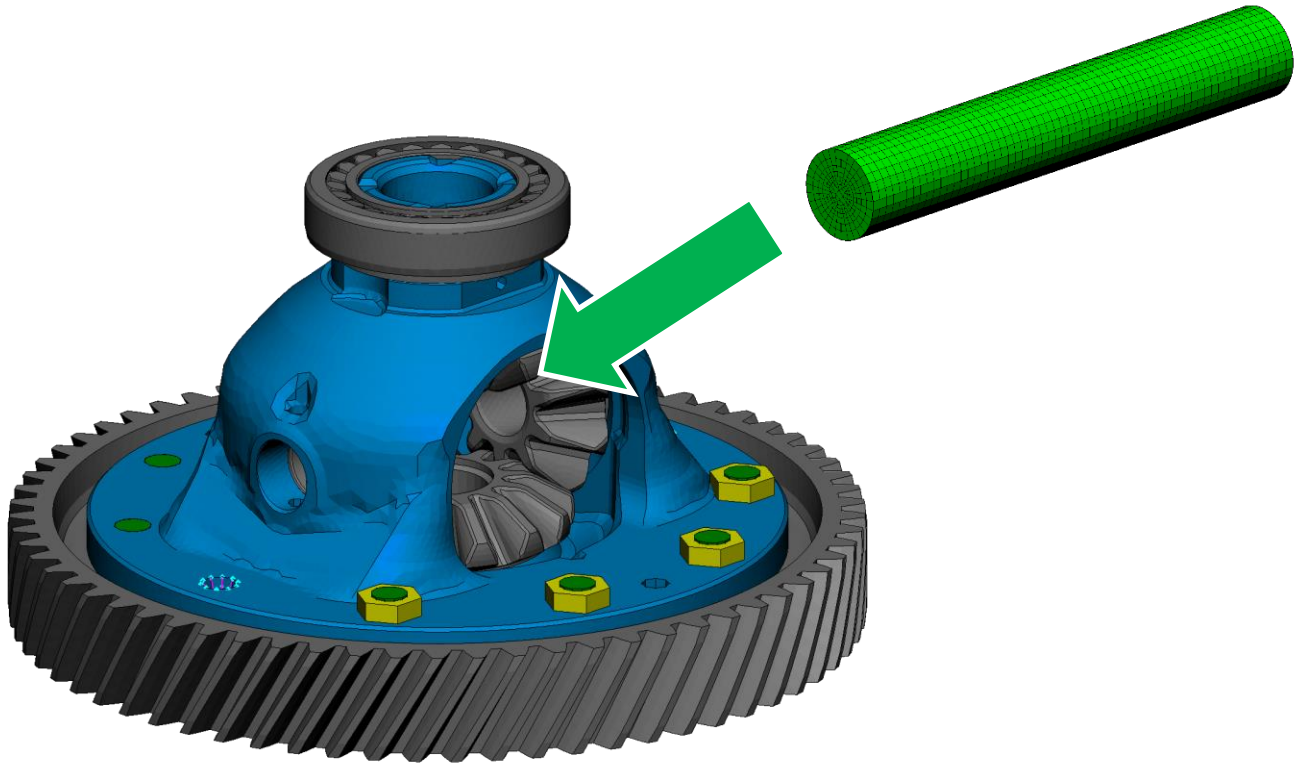
Differential - Model Overview



+ 23 Contacts Definitions
- At roller of bearings
- Between teeth of gears
- Between all parts

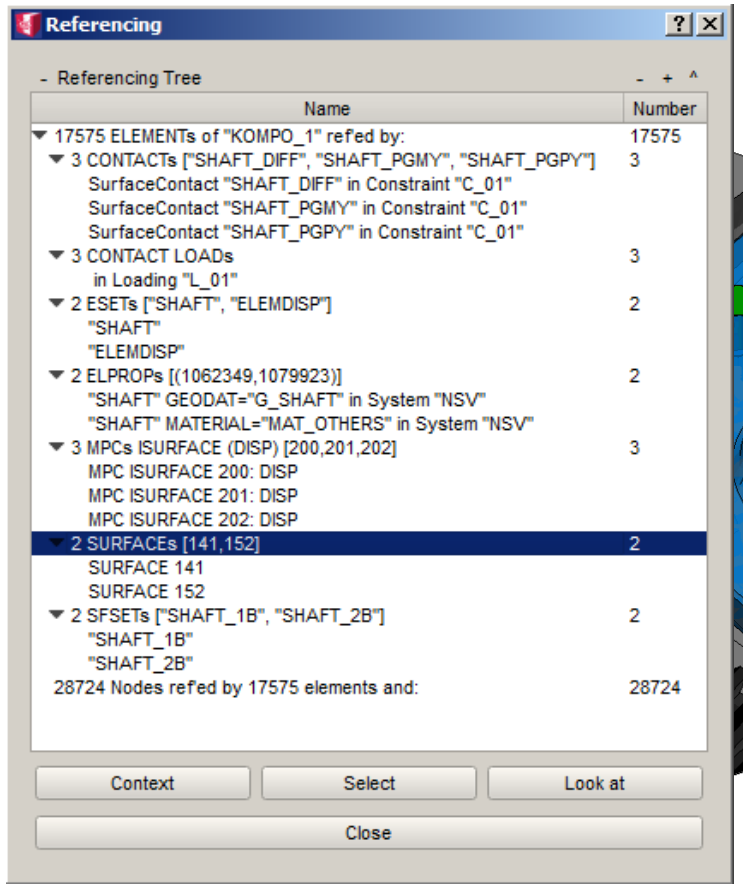
1. Add Missing Shaft

- Add new mesh to complete the assembly
- Automatic relabeling for conflicting IDs
  - Several relabel policies available
- Optional positioning
  - to correct misalignment, wrong direction, different origin, …
- Extensive functionality to create connections
  - MPCs,
  - Contact,
  - Pretension,
  - Pressfit,
  - …



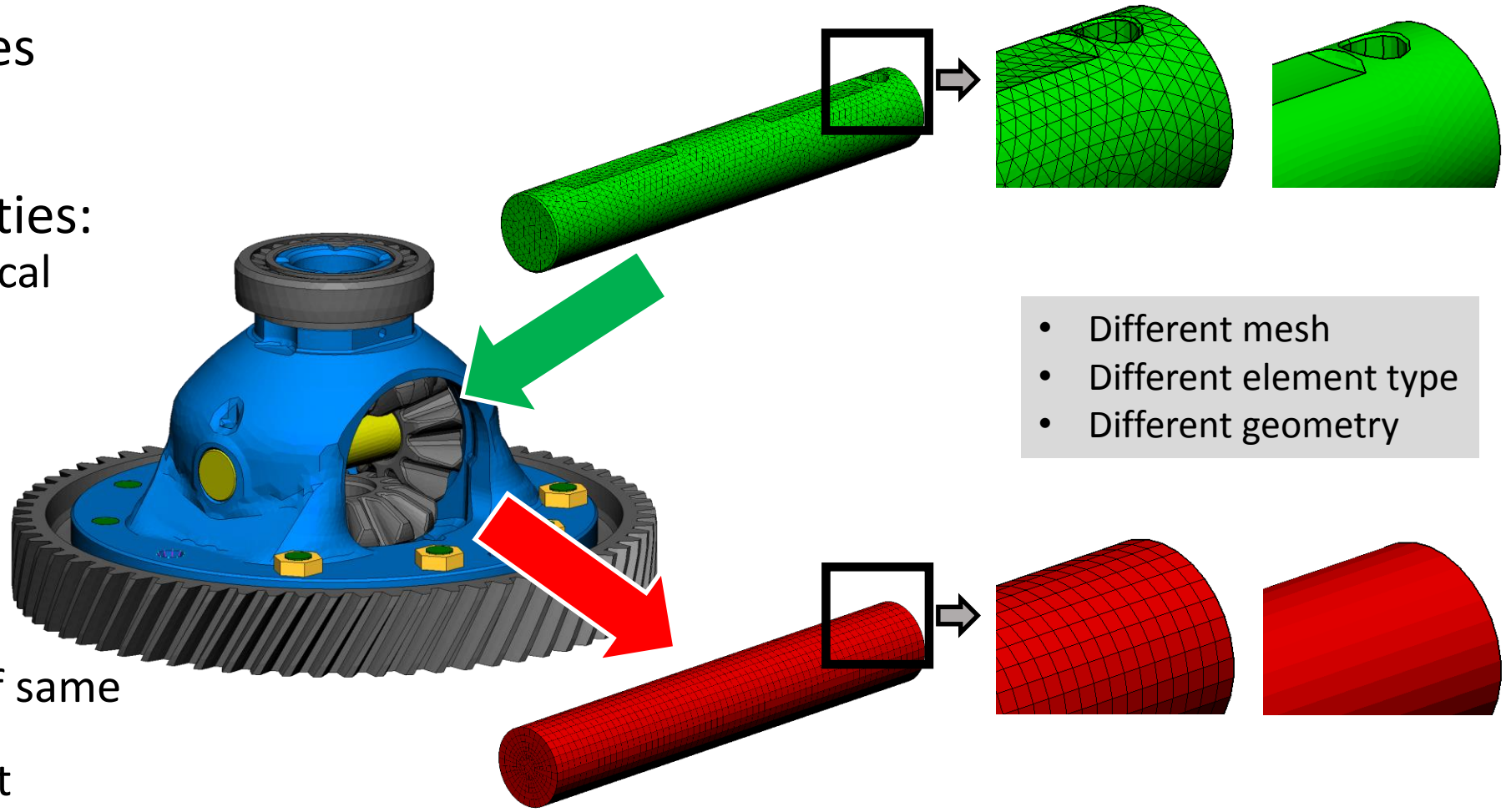
Shaft: Referencing

- ***VisPER*** knows the context of selection
- Visualization by „Context“ button
- Check model and definitions in the most natural way
- Classic check, e.g. check all surfaces/contacts, sets, …, also available



2. Replace Initial Shaft by New Design

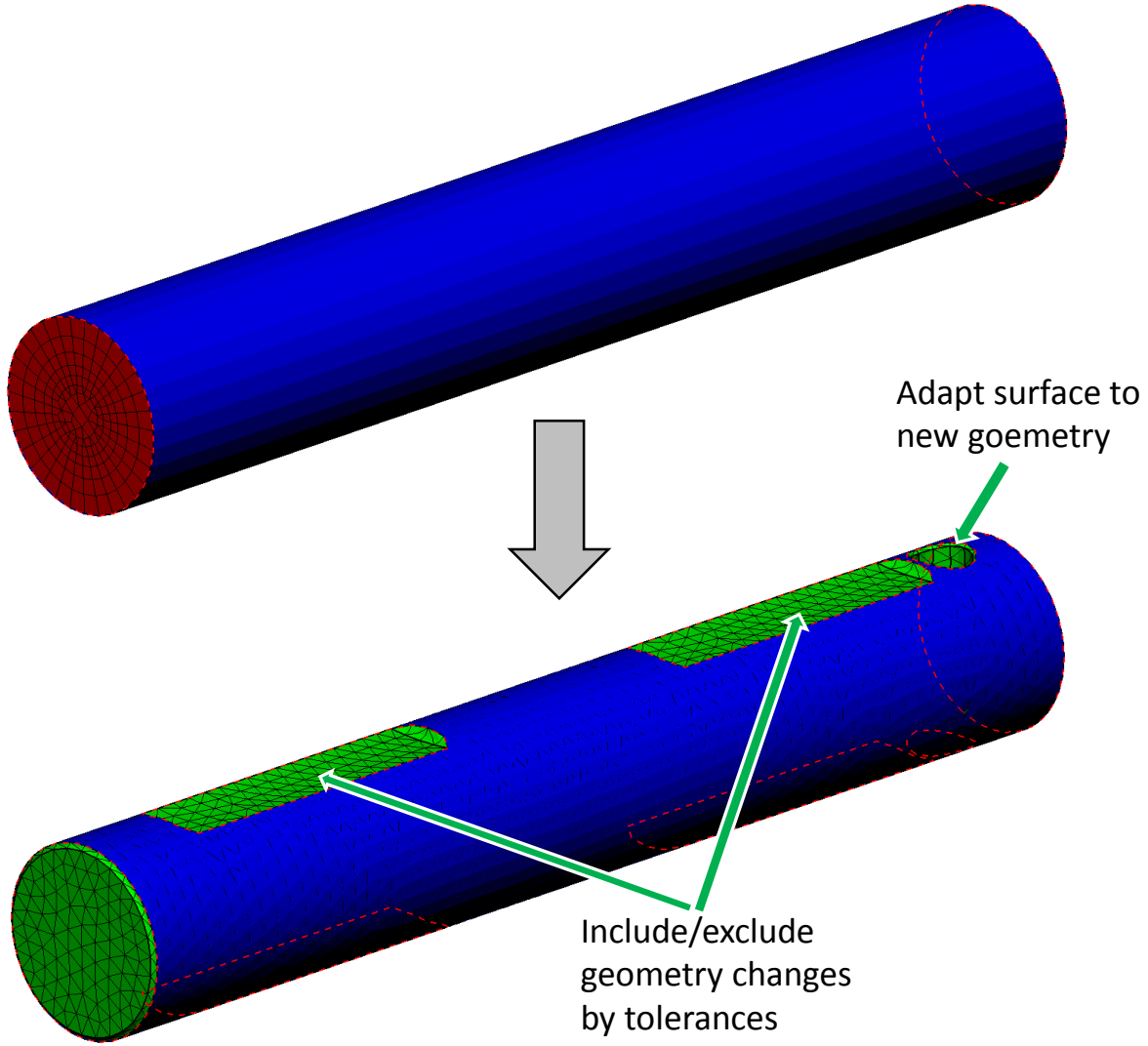
- AssemblyWizard guides through the complete replace process.
- Important Functionalities:
  - Recover existing physical connections
  - Manage replaced and imported part simultaneously during replace step
  - Recover existing sets
  - Fit surfaces to new geometry
  - Relabel IDs, but use of same label range is possible
  - Keep model consistent
  - Undo possibility



- Different mesh
- Different element type
- Different geometry

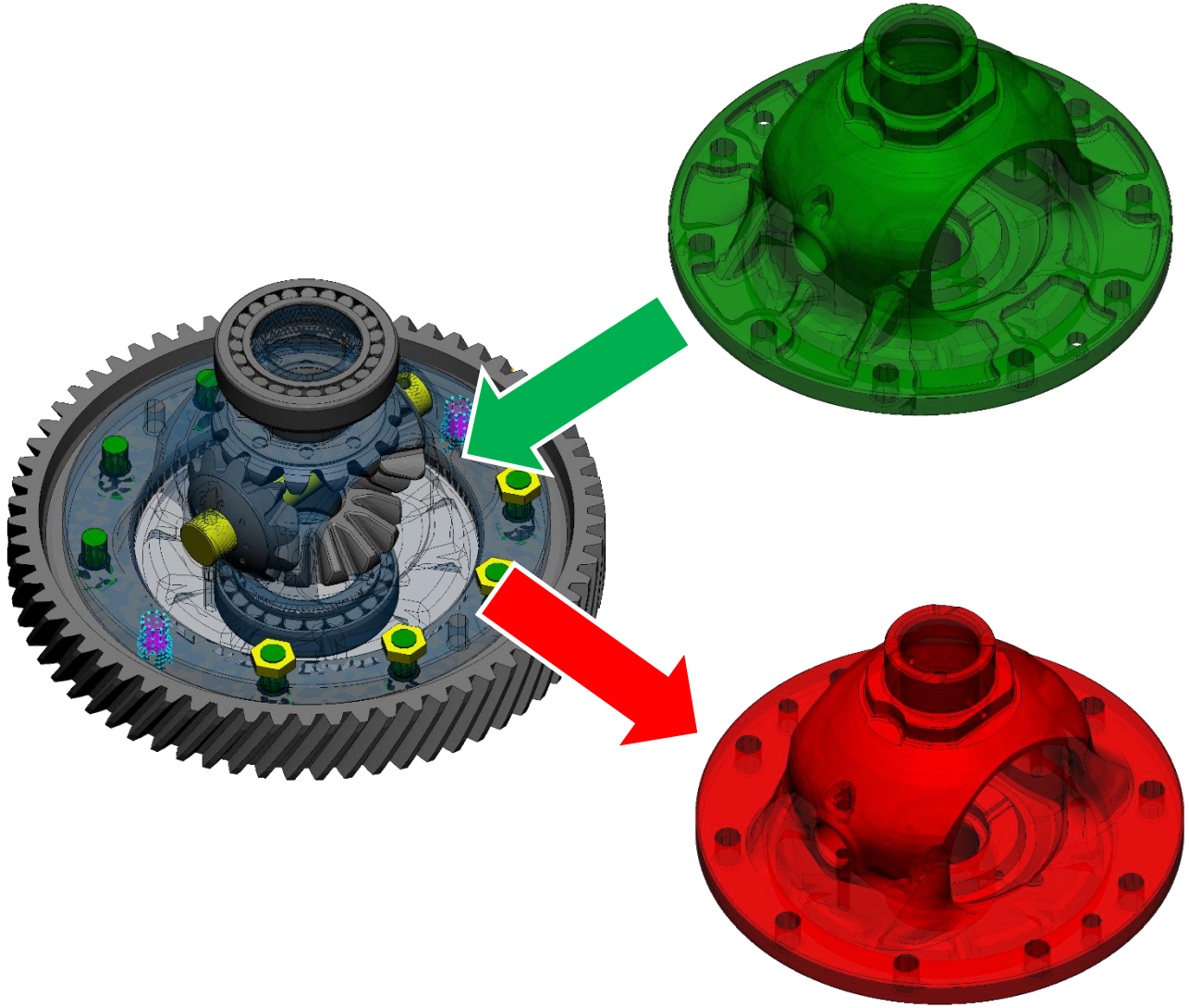
Reconnect Surfaces

- Reconnect Surfaces:
  - Automatic recover surfaces based on new model geometries
  - Tolerances for systematic selection
  - Manual modification of surfaces (optional)
  - Re-use of same surface labels
  - Automatic re-use of new surfaces for existing connections, e.g. contact definitions



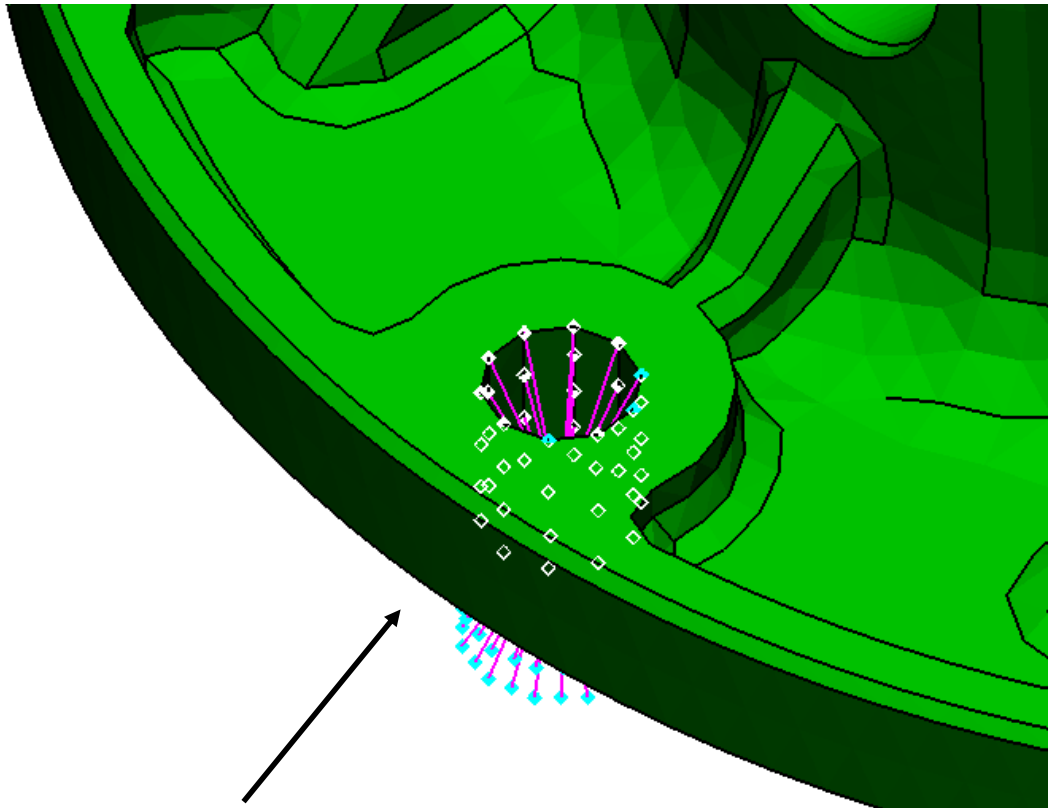
3. Replace Initial Case by New Design

- More challenging task: replacement of differential case
- Physical connections:
  - Contact to rings, washer and gears
  - Contact to shaft
  - MPC coupling to bearings and ring gear
  - 4 MPC couplings to nuts
  - 4 Pretension definitions to bolts
  - 2 node based MPC couplings (bolts)



Reconnect Nodes

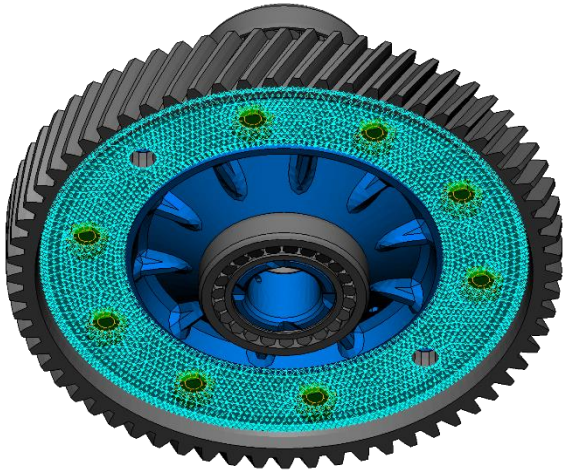
- Reconnect Nodes:
  - Automatic search of node partner between both variants
  - Tolerances for systematic selection
  - Optional exclusive selection of type:
    - boundary or inner nodes, and accordingly
    - corner or mid nodes.
  - Node type-sustaining
  - Manual connection of nodes (optional)
  - Re-use of same node labels

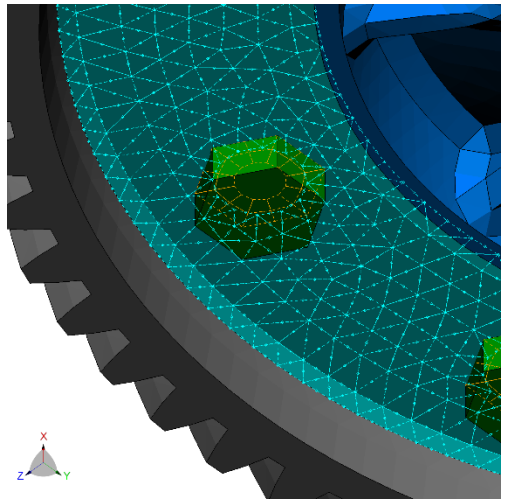


Highlight of nodes for which new connections were found at new part

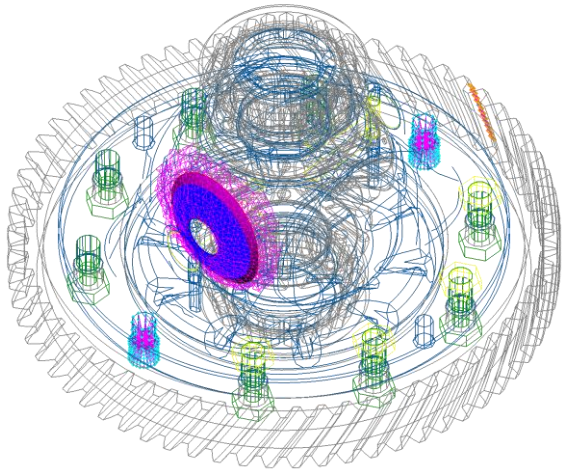
More Examples for Reconnections

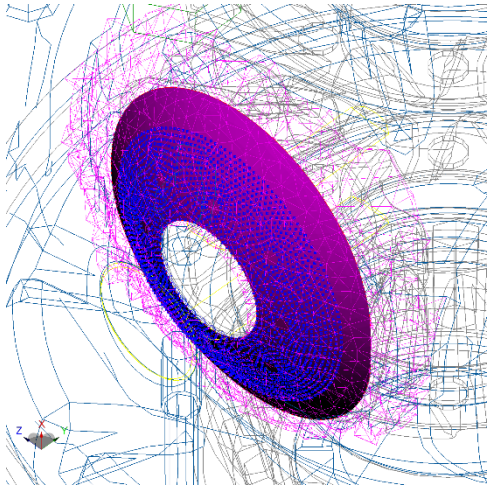
MPC Isurface to Bolt Heads



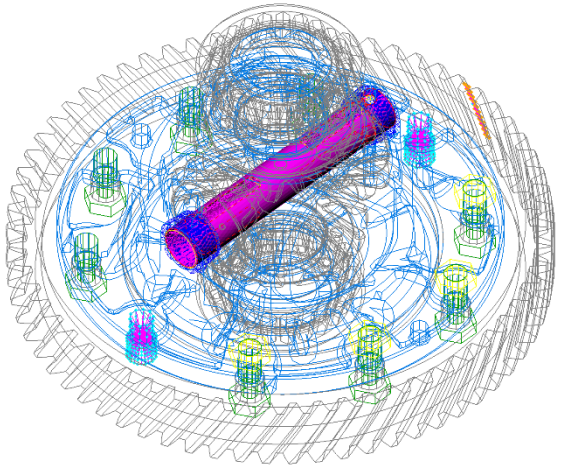


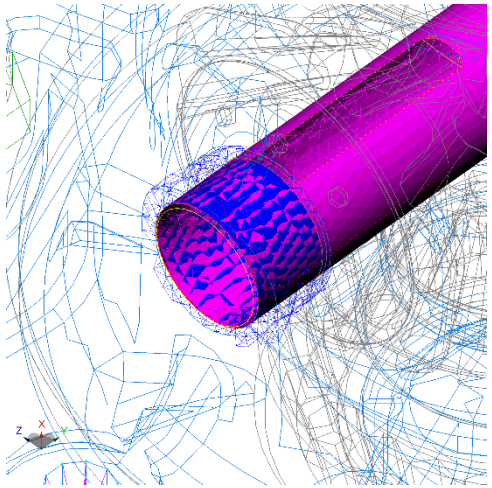
Contact to Gear



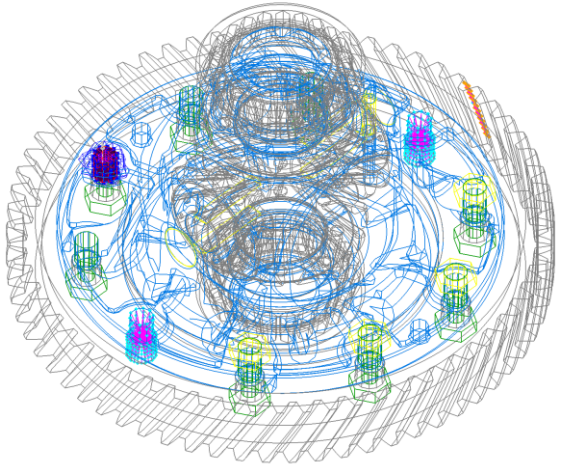


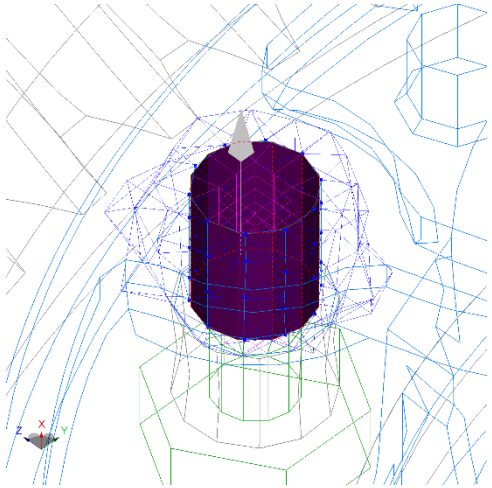
Contact to Shaft





Pretension Thread





Process Comparison

- Comparison of process time for replacement of model part

- Not included are time savings from:
  - less mistakes,
  - better overview and
  - better checking in VisPER!

- Additional Remarks:
  - Automatization by Python-scripts available,
  - Work time saving for each replacement and
  - Maschine time saving by using of ‘CASO’ for PERMAS run of variants

Conclusion

- Drastic acceleration of assembly process
- Reduction of errors during assembly
- No dull redefinition work

- Prepared for complex FEM-models from specialists
- Automatisms for nearly every physical connection
- Complete user-control of reconnection possible
- Checking during replacement with VisPER management of old and new model part at the same time