

# Advanced Techniques for Predicting Mechanical Product Design via COMSOL Multiphysics<sup>1</sup>

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**Introduction:** CAE simulation has been widely applied for predicting virtual product designs for a few decades. However, it is prohibitive to efficiently predict product designs with joint connections or contact interactions because of severe nonlinearity and stress concentration. This study applies COMSOL Multiphysics to effectively simulate these problems.

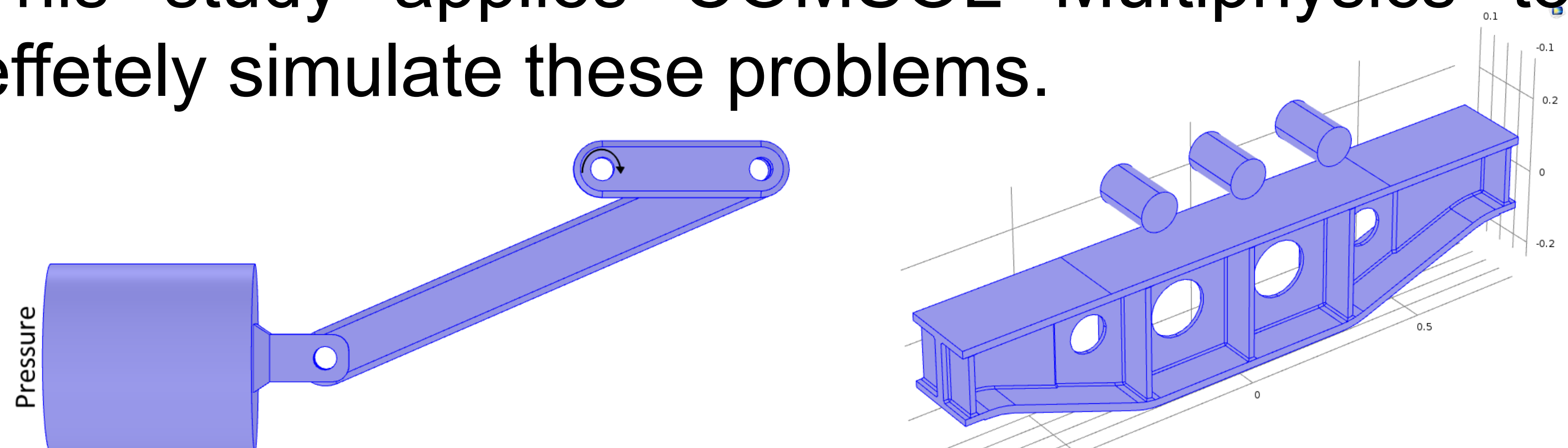
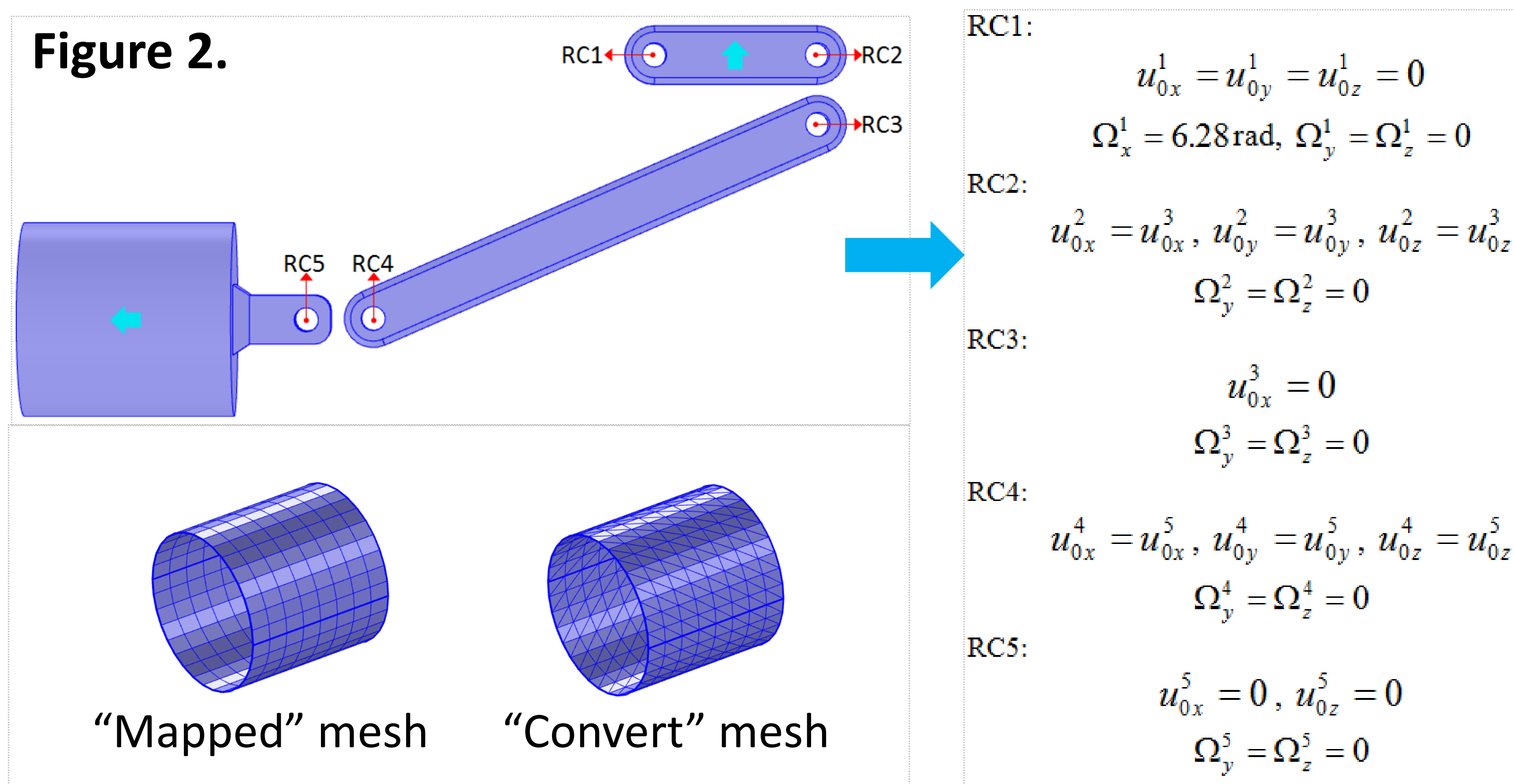


Figure 1. Challenging issues: (a) Joint connection, (b) contact

**Computational Methods:** Figure 2 shows 5 rigid connectors (RC1~RC5) are defined to represent joint connections. Joint surfaces are meshed with “Mapped” and “Convert” nodes.



Penalty method is applied for contact treatment. Figure 3 shows contact checking and contact pressure calculation.

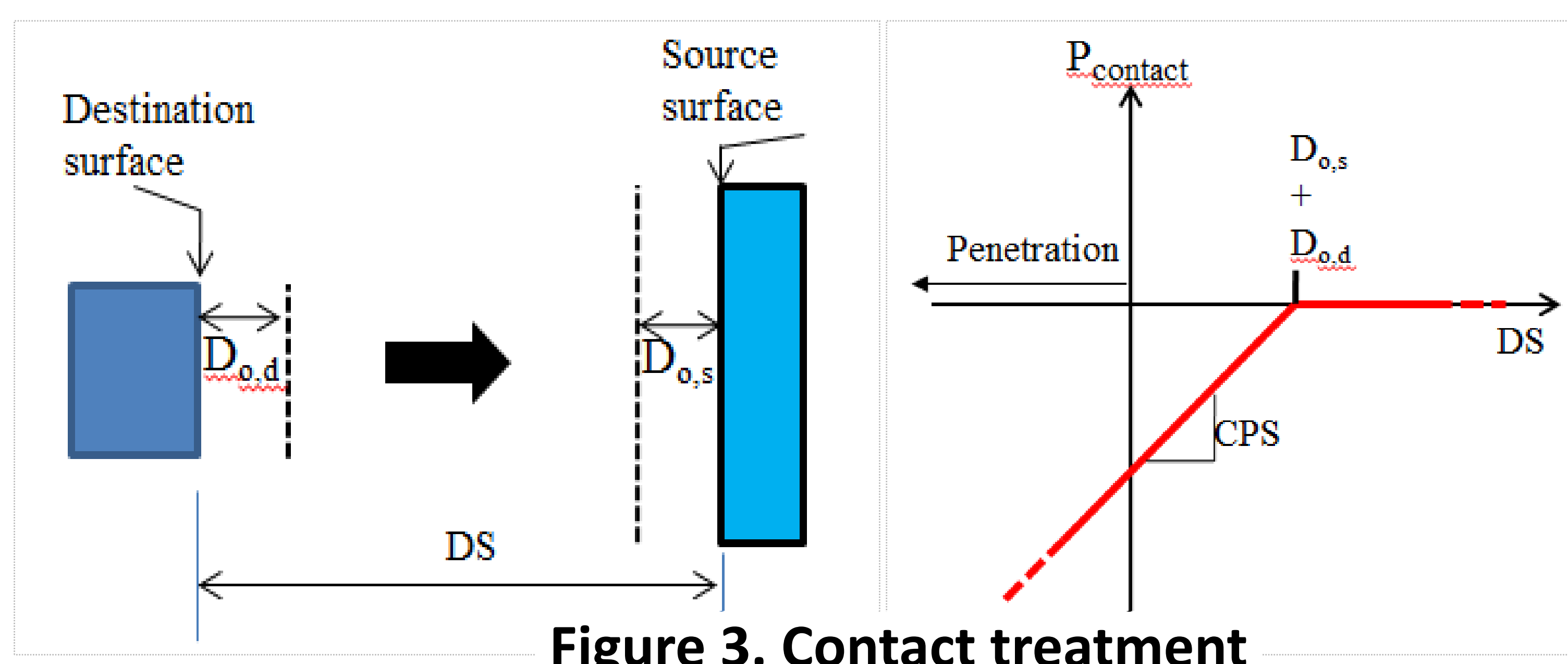


Figure 3. Contact treatment

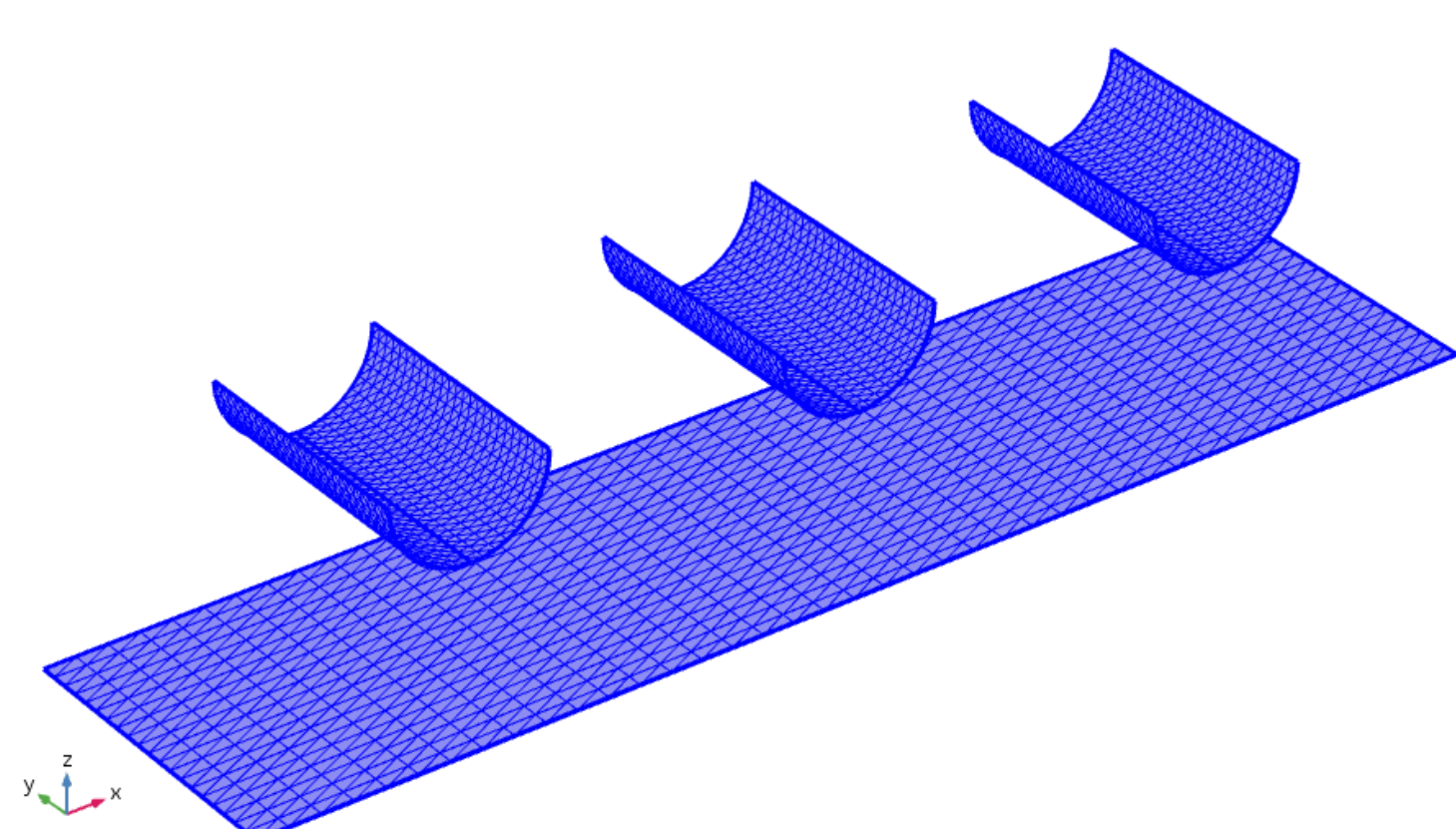


Figure 4. Definition of contact pair and meshed contact surfaces using “Mapped” and “Convert” nodes

**Results:** Figure 3 shows the simulated results of piston with rigid connectors, which well represent the joint connections. Figure 4 shows, using penalty method, COMSOL Multiphysics can well predict virtual structures w/ contact.

0 rad

1.57 rad

3.14 rad

4.71 rad

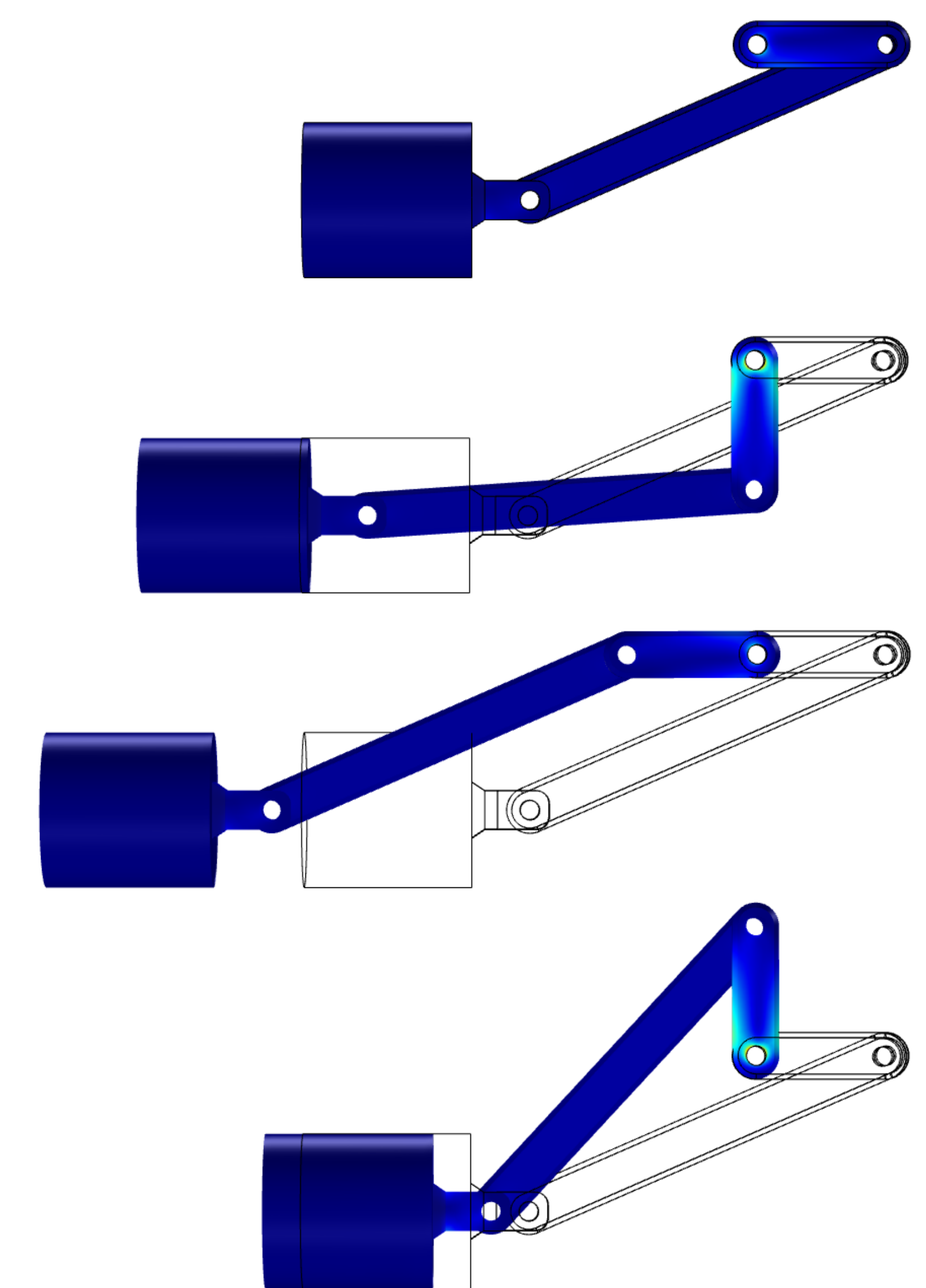


Figure 5. Simulated results of piston

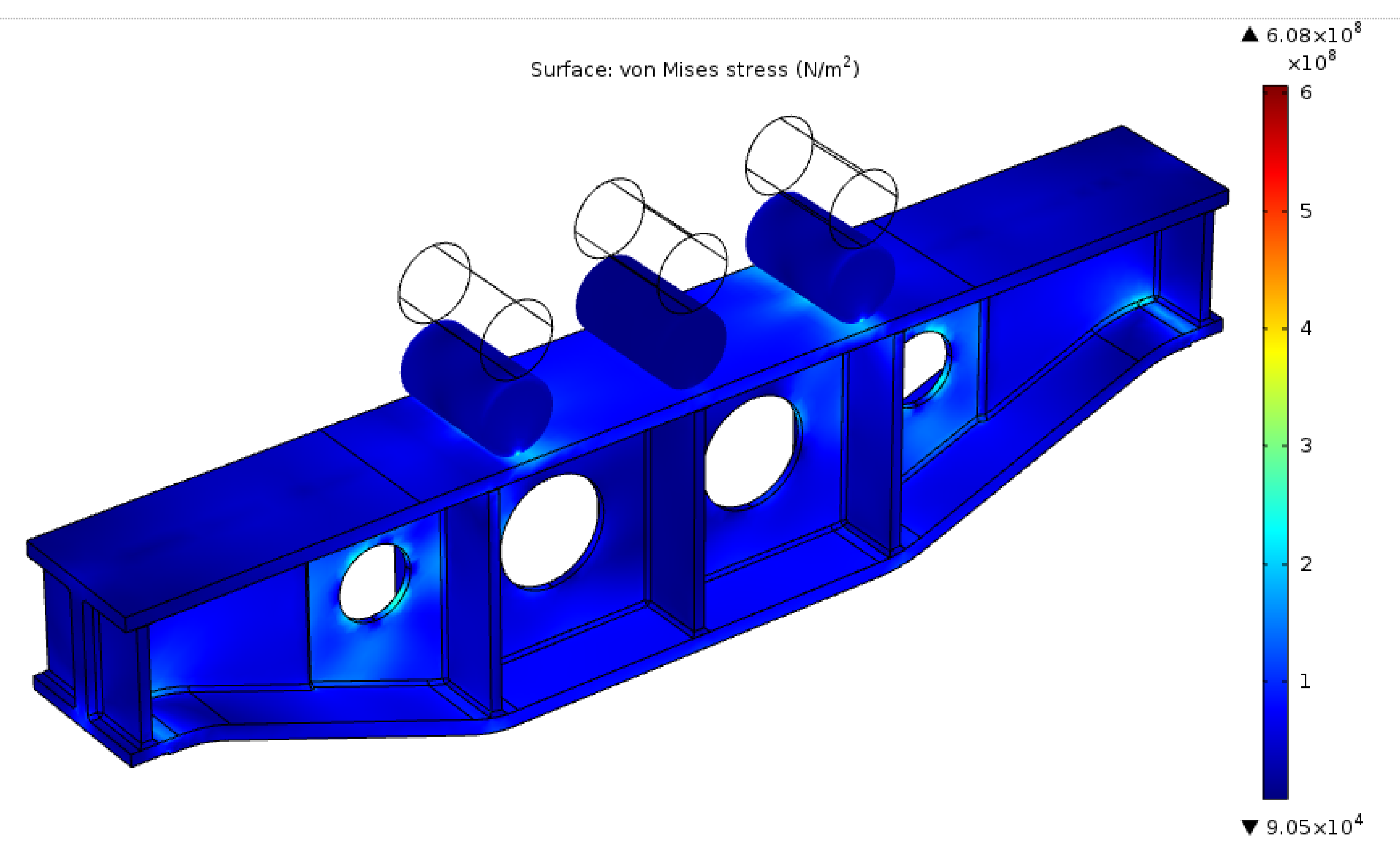


Figure 6. Simulated steel beam under contact

**Conclusions:** In COMSOL Multiphysics, rigid connectors can represent joint connections to enhance the performance of modeling, meshing and simulation. Contact definition can be easily set up in COMSOL Multiphysics. By use of penalty method, steel beam under contact is successfully simulated.