# NAFEMS UK Regional Conference 2018 - Abstract Submission

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| **Please identify the event for which your submitting?** | NAFEMS UK Conference 2018 |
| **Will you be the presenting author?** | Yes |
| **Presentation Title** | CONTACT ASSEMBLY SEQUENCE MODELING |
| **Relevant Themes / Keywords** | Contact Mechanics; Finite Elements; Mortar Methods; Patch Test; Assembly Sequence Modelling, Bonded Contact, Rough Contact, No-Separation Contact, Bolt, Cyclic Symmetry, Plasticity |

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| **Abstract (plain text)** | CONTACT ASSEMBLY SEQUENCE MODELING<br>Vijay Narayanan, Jim Bernard<br>Numerical simulation of contact problems using finite elements plays an important role in a vast array of engineering applications such as in aerospace, automotive, locomotive and shipbuilding industries etc. Variables such as friction, large deformations, finite sliding, plasticity and wear introduce additional complexities that call for stable, robust, accurate yet efficient solutions to contact problems.<br>In recent years there has been a growing need for integrating complex subsystems and assemblies thanks to advancements in computing, meshing and solver technologies. These individual components from different vendors are typically meshed independent of one another and need to be assembled together using interactions such as contact or special cases of contact like bonded or sliding or rough behavior. Many times, these contact interactions are created and introduced sequentially in an analysis to simulate press fits or in conjunction with bolt preloads.<br>In this regard, the following types of contact are considered:<br>1. Standard contact: General segment-segment contact algorithm with or without friction.<br>2. Rough Contact: Similar to standard contact but does not allow sliding by assuming infinite friction.<br>3. Bonded/Tied Contact: Weld like behavior with no relative displacement in normal and tangential directions.<br>4. No-Separation Contact: Frictionless free to slide formulation where there can be no relative displacement only in the normal gap direction.<br>The contact formulation for all the interface types described above is implemented as a segment-segment method involving a surface refinement approach similar to that of a mortar based methods. This algorithm passes the constant stress patch test and produces excellent quality of contact stress results across the interface.<br>An example model showing a simplified representation of several components of an axial gas turbine is presented. The individual components are connected through standard, rough and bonded contact types. The analysis sequence is carried out in a multi-step process alternating between press fits and bolt tightening. Once assembled, structural loads are introduced in additional steps. Cyclic modes are solved at intermediate points as linear perturbations taking into account differential stiffness from prior static load steps. Finally the bolts are unloaded sequentially to study any residual plastic deformations in the model.<br>KEY WORDS: Contact Mechanics; Finite Elements; Mortar Methods; Patch Test; Assembly Sequence Modelling, Bonded Contact, Rough Contact, No-Separation Contact, Bolt, Cyclic Symmetry, Plasticity |
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