ASSEMBLY MODELING OF AEROSPACE STRUCTURES USING CONTACT SIMULATION

Hanson Chang

Sr. Lead Application Engineer

MSC Software Corporation, USA

4675 MacArthur Court

Newport Beach, California 92660

+1 (714) 540 8900 ext. 4262

hanson.chang@mscsoftware.com

KEYWORDS

assembly modeling, aerospace, airframe, contact, glued contact, tied contact, touching contact, bolted joint, fastener, connector, interaction, gap, overlap, ply drop-offs, load path, load distribution

ABSTRACT

Bolted or riveted airframe assemblies are traditionally modeled as continuous meshes. But advances in meshing and solver technology are changing the way we model these assembly structures. Today, continuous meshes are often replaced by individually meshed parts joined together by some type of connector or interaction definition.

These individually meshed parts are typically joined together using either discrete fasteners (CFAST, CBUSH, etc.) or glued contact (aka tied contact).

The first method, which uses discrete fasteners, provides more accuracy at the expense of modeling time. The discrete fasteners can be combined with touching contact to further improve accuracy. Touching contact prevents parts from penetrating each other, thus providing more accurate load paths, better stiffness representation, and better load distribution results. In this method, modeling effort is required to generate and apply the fastener properties. And touching contact simulation will add additional solution time in order to achieve convergence.

The second method, which uses glued contact simulation, can be defined and applied rapidly without specific fastener connection property data. This is important for defining contact in a large vehicle-level assembly with hundreds of fastened connections. However, glued contact represents a rigid connection which could

potentially affect load distribution accuracy. One example of this is the overestimation of end loads and peaking at runout details and part edges.

This paper will present the benefits of adding contact simulation to aerospace assembly models, including improved accuracy in load paths and reduced modeling time. It will also address the limitations of contact modeling. Both touching contact and glued contact will be discussed in detail using real-world aerospace examples.

This paper will also present lessons learned and modeling guidelines to help the structural analyst decide when and where to apply contact simulation to the assembly models. Tips on how to handle gaps and overlaps caused by as-built conditions due to manufacturing tolerance stack up and shimming or ply drop-offs will be discussed. Post-processing techniques for extracting glued contact loads for subsequent joint sizing analysis will also be presented.