

CONTACT MODELING OF MAV CLAPPING WINGS

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Wings of Micro Aerial Vehicles (MAVs) are typically flexible and the deformation influences the aerodynamics and how the lift and thrust are generated. This is a fluid–structure interaction (FSI) problem. In this research, we model an MAV with clapping wings. The upper and lower wings contact each other as they flap. With a special space–time method [1], we successfully computed the aerodynamics of flapping like that, but with the wing motion prescribed [2]. As we now focus on FSI modeling with the wing deformation solved for, we develop a contact model needed for that. The contact model is based on the Surface-Edge-Node Contact Tracking (SENC-FC) technique [3], which originates from the SENCT technique introduced in [4], and using NURBS in representing the wing geometry and collocation points instead of the "contacted nodes" of the SENCT-FC technique (see Figures 1 and 2). Figure 3 shows the results from the structural mechanics computation of flapping wings of a dragonfly MAV with wing clapping.

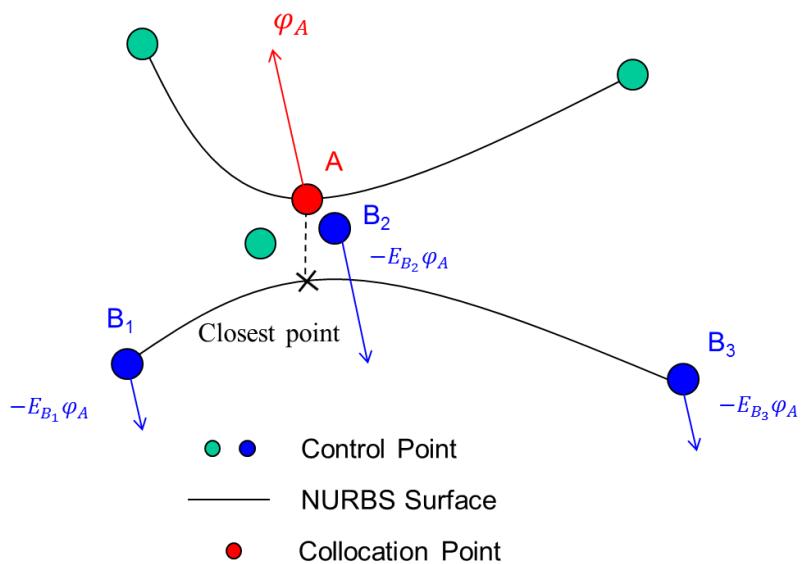


Figure 1. SENCT-FC contact modeling [3] with NURBS representation of the surfaces and collocation points.

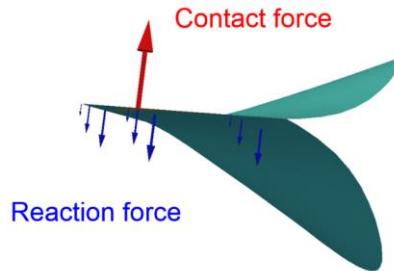


Figure 2. Contact force acting on a "contacted collocation point" and the distribution of the reaction force to the "contacting control points."

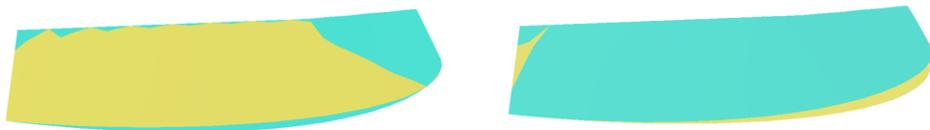


Figure 3. Flapping wings of a dragonfly MAV with wing clapping at an instant during the structural mechanics computation, without (left) and with (right) the contact model. As can be seen in the figure, the wings cross each other when there is no contact model.

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