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Improvement of Bicycle Wheel CFD using Blade Element Momentum ANDREW VIGNE, GEORGE LOUBIMOV, MICHAEL KINZEL, University of Central Florida — The cycling industry has long relied on expensive wind tunnel testing when designing new aerodynamic products. However, with the recent advent of computational fluid dynamics (CFD), the industry now has an economical tool that supplements this iterative design process. While current CFD methods can reliably simulate static bicycle components, the complex aerodynamics of rotating, spoked wheels make them particularly difficult to efficiently simulate as they consume valuable computational time. This research investigates a new CFD method that can accurately model a bicycle wheel at a lower computational cost. A 3D model of a hub, rim, and tire all rotate using overset mesh techniques atop a transversely moving ground plane. Blade Element Momentum (BEM) techniques are then used to model rotating spokes. BEM has never before been used for cycling applications but has a demonstrated history for effectively modeling aerodynamic performances of helicopter and wind turbine blades at a lower computational cost than simulating these 3D geometries directly. Preliminary results suggest that employing BEM on a bicycle wheel has a similar effect, all while accounting for relevant fluid scales and yielding force/moment data comparable to wind tunnel experiments.

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