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Scaling of hydrodynamics and swimming kinematics of shelled Antarctic sea butterfly DEEPAK ADHIKARI, DONALD WEBSTER, JEANNETTE YEN, Georgia Tech — A portable tomographic PIV system was used to study fluid dynamics and kinematics of pteropods (aquatic snails nicknamed 'sea butterflies') in Antarctica. These pteropods (*Limacina helicina antarctica*) swim with a pair of parapodia (or "wings") via a unique flapping propulsion mechanism that incorporates similar techniques as observed in small flying insects. The swimming velocity is typically 14 – 30 mm/s for pteropod size ranging 1.5 – 5 mm, and the pteropod shell pitches forward-and-backward at 1.9 – 3 Hz. It has been shown that pitching motion of the shell effectively positions the parapodia such that they flap downwards during both power and recovery strokes. The non-dimensional variables characterizing the motion of swimming pteropods are flapping, translating, and pitching Reynolds numbers (i.e. Re_f, Re_U, and Re_Ω). We found that the relationship between these Reynolds numbers show an existence of a critical Re_Ω, below which pteropods fail to swim successfully. We explore the importance of this critical Re_Ω by changing the viscosity of the seawater using methylcellulose. At higher viscosity, our results indicate that pteropods do not swim with optimal propulsion efficiency. Finally, we examine the wake signature of swimming pteropod, consisting of a pair of vortex rings, in the modified viscosity environment.

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