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Optimal lamellar arrangement in fish gills[1] KEUNHWAN PARK, School of Mechanical and Aerospace Engineering Seoul National University, Korea, WONJUNG KIM, Department of Mechanical Engineering, Sogang University, Korea, HO-YOUNG KIM, School of Mechanical and Aerospace Engineering Seoul National University, Korea — We present the results of a combined theoretical and experimental investigation of the oxygen transport in fish gills. Efficient respiration is crucial to fish because of relatively low oxygen contents in water compared to that in air. Ordered structures of lamellae of fish gills offer extended surfaces for oxygen transport. While the more compact arrangement of the lamellae provides larger surface area for oxygen diffusion, it causes higher viscous resistance to water flow through the interlamellar space. This allows us to expect the optimal lamellar arrangement for maximizing the oxygen transport. By developing a dynamic model for oxygen transport in fish gills, we calculate optimal lamellar arrangement for maximizing oxygen transport. We demonstrate that the interlamellar distance of a broad range of fish species is consistent with the deduced optimal lamellar arrangement. Our results thus provide the first rationale for the relatively uniform interlamellar distance of many fish regardless of their size, appearance, and habitat.

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