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**Bio-mimetic Flow Control**[1]

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Bio-mimetic engineering or bio-mimetics is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology (from Wikipedia). The concept itself is old, but successful developments have been made recently, especially in the research field of flow control. The objective of flow control based on the bio-mimetic approach is to develop novel concepts for reducing drag, increasing lift and enhancing aerodynamic performance. For skin friction reduction, a few ideas have been suggested such as the riblet from shark, compliant surface from dolphin, microbubble injection and multiple front-body curvature from penguin, and V-shaped protrusion from sailfish. For form drag reduction, several new attempts have been also made recently. Examples include the V-shaped spanwise grooves from saguaro cactus, overall shape of box fish, longitudinal grooves on scallop shell, bill of swordfish, hooked comb on owl wing, trailing-edge protrusion on dragonfly wing, and fillet. For the enhancement of aerodynamic performance, focuses have been made on the birds, fish and insects: e.g., double layered feather of landing bird, leading-edge serration of humpback-whale flipper, pectoral fin of flying fish, long tail on swallowtail-butterfly wing, wing flapping motion of dragonfly, and alula in birds. Living animals adapt their bodies to better performance in multi purposes, but engineering requires single purpose in most cases. Therefore, bio-mimetic approaches often produce excellent results more than expected. However, they are sometimes based on people's wrong understanding of nature and produce unwanted results. Successes and failures from bio-mimetic approaches in flow control will be discussed in the presentation.

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