Biomimicr-E: Nature-Inspired Energy Systems

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Biomimicry (also known as biomimetics) is the process of using natural-world mechanisms, many of which have evolved over billions of years, to inspire man-made designs and technological innovations. The following examples highlight pioneering energy ideas and active areas of research, all inspired by nature.

Energy Efficiency

- **Termite mounds** inspired regulated airflow for temperature control of large structures, preventing wasteful air conditioning and saving 10% energy.[1](http://http://bioinspiration.sandiegozoo.org/content/bioinspiration-story)
- **Whale fins shapes** informed the design of new-age wind turbine blades, with bumps/tubercles reducing drag by 30% and boosting power by 20%.[2](http://www.pratt.duke.edu/news/mimicking-humpback-whale-flippers-may-improve-airplane-wing-design)[3](http://bioinspiration.sandiegozoo.org/content/bioinspiration-story)[4](http://www.whalepower.com/drupal/?q=node/1)
- **Stingray motion** has motivated studies on this type of low-effort flapping glide, which takes advantage of the leading edge vortex, for new-age underwater robots and submarines.[5](http://www.popsci.com/article/technology/why-underwater-robots-should-swim-stingrays?dom=PSC&loc=recent&Ink=5&con=why-underwater-robots-should-swim-like-stingrays)[6](http://www.mnn.com/earth-matters/animals/stories/what-submarines-can-learn-from-stingrays)
- Studies of microstructures found on **shark skin** that decrease drag and prevent accumulation of algae, barnacles, and mussels attached to their body have led to “anti-biofouling”
technologies meant to address the 15% of marine vessel fuel use due to drag.[7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26]

Energy Generation

- Passive heliotropism exhibited by sunflowers has inspired research on a liquid crystalline elastomer and carbon nanotube system that improves the efficiency of solar panels by 10%, without using GPS and active repositioning panels to track the sun.[11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26]

Energy Storage

- Inspired by the sunlight-to-energy conversion in plants, researchers are utilizing a protein in spinach to create a sort of photovoltaic cell that generates hydrogen from water (i.e. hydrogen fuel cell).[18] [19] [20] [21] [22] [23] [24] [25] [26]

Energy Delivery

- Mimicking the sharp, jagged scales found on fireflies by implementing radiance-amplifying geometry has been shown to increase LED brightness by 55%.[22] [23] [24] [25] [26]

- The distributed social structure of ants and bees, specifically for communication and activity scheduling, is influencing the complex and adaptive control systems required for smart grids.[24] [25] [26]

- Neural networks found in the human brain are inspiring intelligent control systems for future...


NOTE: If you would be willing to share additional examples of biomimicry in the energy world or would like to collaborate on future work, please reach out to Noël and Kristen. Please direct interest in co-authoring grants/proposals on biomimicry research for energy systems to Andrea (http://www.cs.rug.nl/~andrea/projects/biomimicry/Biomimicry_in_energy.html).

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