Journal of Applied Mechanical Engineering
ISSN: 2168-9873

Leng Chuan et al., J Appl Mech Eng 2015, 4:1
DOI: 10.4172/2168-9873.1000150

Short Communication Open Access

Applying Nature's Best Ideas to Biomimetics: Frog Calling

Leng Chuan Y[1], Enamul Hoque M[2*], Chan Jian Sheng[1], Saktiyaramana Karpayah[1] and Mohammad Hossein Sharifi[1]

[1]*Department of Mechanical Engineering, Taylor's University Lakeside Campus, Malaysia*

[2]*Department of Mechanical, Materials and Manufacturing Engineering, University of Nottingham Malaysia Campus, Malaysia*

[*]**Corresponding author:** Enamul Hoque M, Department of Mechanical, Materials and Manufacturing Engineering, University of Nottingham Malaysia Campus, Malaysia, Tel: +6 (03) 8924 8367; E-mail: enamul.hoque@nottingham.edu.my

Received date: January 20, 2015; **Accepted date:** January **27, 2015**; **Published date: February 07, 2015**

Short Communication

Nature inspired innovation has been progressively contributing to scientific advancements through applying natural concepts into design and manufacturing of artificial real-world appliances [1]. This brief communication specifically highlights on how frogs' astonishing ideas and inspirations contribute to biomimetics.

Scientist have recently discovered and paid attention to one of the behaviors exhibited by the frog that has sparked their interests. This behavior may appear annoying to most people, especially after rainy nights –The Frog Calling. Frog calling is a behavior exhibited by most of the male frogs to attract female frogs that are able to locate them from their vocal expression. This activity usually happens after rainy nights, as there will be a higher probability of formation of water pools, or fewer chances of wet areas being dried out. It is mandatory natural process for frogs to lay eggs in water. So how, and for what purpose are we mimicking frog callings?

Frogs, more specifically male Japanese tree frogs haves learnt the ability to "co-operate" with other male frogs so that they will not call at the same time to prevent confusion. This is also known as "desynchronization", where the frogs are capable of timing their vocal expression at different intervals in order to prevent overlapping. Therefore, by desynchronization, a female frog then has the capability to differentiate between the vibrations showcased by each male frog and is capable to accurately and precisely locate her preferable choice. Research and investigation have shown by the Polytechnic University of Catalonia that frog callings actually can help us in improving wireless connection networks [2].

When nodes of wireless networks are connected to each other, colours are assigned to each node in order to ensure that each pair of nodes is not in the same colours. This technique is also known as Distributed Graph Colouring. However, there is a probability that these nodes will overlap among colours, causing an inefficient connection. Frog distinct "desynchronization" behavior of male frogs has lead researchers in the mentioned institute to develop an entirely new mathematical algorithm [3]. By assigning the new mathematical algorithm, the overlapping of colours between nodes are eliminated, thus avoiding or mitigating electrical interference in Wi-Fi connections, ultimately providing a stable and reliable network. The outcome of this new mathematical algorithm results in a staggering improvement in 90% of the studies and investigations performed during the experiment conducted by the Hernandez and Blum from the Polytechnic University of Catalonia. Therefore, modern wireless networks are optimized in terms of productivity and energy efficiency, all thanks to the inspirations obtained from frogs.

Other than the frog calling inspiration, a research team from the National University of Singapore (NUS) has successfully developed an innovative one-step method to grow and transfer high-quality graphene grown on silicon wafers [4]. The inspiration attained for this method came from observing how tree frogs keep their feet attached on leaves submerged in water. Tree frogs use trapped bubbles on their feet in order to stay afloat on submerged leaves. The bubbles form capillary bridges: stretched structures that exert an inward force on both ends, holding them together. It is the same effect that holds a sand castle together

In 2013, researchers at the University of Leeds has used the feet of tree frogs as an inspiration for the design of a tiny robot aimed to crawl inside patients' bodies during keyhole surgery. Keyhole surgeries are carried out through a very tiny opening, which require very special instruments to operate [5]. These tiny little frog-like robots are designed to move across the internal abdominal wall of a patient, allowing surgeons to see what they are doing on a real-time video feed. This is an amazing inspiring story of how frogs are able to inspire the biomedical engineering field, and aid doctors in performing keyhole surgeries.

The tree frog's feet are able to provide a solution to the critical problem of getting the device to hold onto wet, slippery tissue when it is vertical or upside down. Although it is relatively easy to find ways of sticking to or gripping tissue, the patterns on the frog's feet offer a way to hold and release a grip without harming the patient. This is due to the hexagonal patterned channels on the feet of tree frogs. When these hexagonal toe pads get in contact with wet surface build capillary bridges, a strong adhesion force is formed [6,7].

In conclusion, looking further into the surviving skills of the frog, the natural biological dissociation mechanism is difficult to be mimicked by man-made materials causing the limitation. Overall, the concept of biomimetic "desynchronization" and frog inspiring surgical robot, are rather innovative, and if it is accustomed to commercial use shall bring enormous steps ahead in terms of future technology.

References

1. Bharat B (2009) Biomimetics: Lessons from Nature–an Overview, Philosophical Transactions of The Royal Society A 367: 1445-1486.
2. Tucker MA, Gerhardt HC (2011) Parallel Changes in Mate-attracting Calls and Female Preferences in Autotriploid Tree Frogs, Proceedings of the Royal Society B: Biological Sciences 279: 1583-1587.
3. Hugo H, Christian B (2012) Distributed Graph Coloring: an Approach based on the Calling Behavior of Japanese Tree Frogs. Swarm Intelligence 6: 117.
4. Scholz I, Barnes WJ, Smith JM, Baumgartner W (2009) Ultrastructure and physical properties of an adhesive surface, the toe pad epithelium of the

tree frog, Litoria caerulea white. The Journal of Experimental Biology 212: 155-162.

5. Laboratory news (2013) Frog-like Robots to Assist Surgery.
6. Federle W, Barnes WJ, Baumgartner W, Drechsler P, Smith JM (2006) Wet But Not Slippery: Boundary Friction in Tree Frog Adhesive Toe Pads. Journal of the Royal Society Interface 3: 689-697.
7. Barnes WJ, Smith J, Oines C, Mundl R (2002) Bionics and wet grip, Tire Technology International 56-60.