

Improvement among sport by dint of biomimicry

LEFAY Paul, CESBRON Théo, HERVE Alexis, GELINEAU Emmanuel, GUYON Soren

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Abstract

Introduction: This article aims to study various applications of biomimicry to improve human lifestyle. We mostly focus here on the sport field. **Methods:** First, we looked for general information around biomimicry. Second, we went into more detail around the articles on biomimicry and sport. **Results:** The experiment on swimsuits shows that the one inspired by shark skin generates less hydrodynamic resistance on all drag forces. Also, the use of biomimicry for the Knee protector leads to a product more resistant. **Discussion:** Biomimicry is useful and is interesting in a lot of different topics. We show in this article that studying nature and animals can be helpful to improve our skills and capabilities.

I Introduction

As for astronomy or transport, sport is a sector where innovations are numerous. For a longtime, sportsmen and sportswomen were trying to achieve better performances by training a lot. The fact is that they finally arrived to the limits of those performances. A way of pushing further those limits is to study new ways of training and additional things to help perform. This article exposes applications of biomimicry : the idea of observing wildlife and transposing its concept in life to solve problems or improve our way of doing things. Through this process, humans have managed to make a lot of progress in very varied fields, sport is notably one of them.

II Methods

Biomimicry has a lot of applications in sport and especially in swimming. In order to improve swimmers' performances, research led to observation of the fastest fish on Earth and copy it. It appears to be the shark. It has a skin that is so peculiar that water just slides on it and in that way, it allows the shark to have barely no resistance under water. The idea is to recreate the shark's skin for swimsuits. Experiments were done to find the best material to use and the best way to sew the suit. Both are making great differences for a swimmer in a race. The first experiment was done in a wind tunnel, the study was to understand the aerodynamics of different materials and ways of sewing those materials. The second experiment is based on hydrodynamics. Swimmers are in the pool, they are towed, and with cameras and force data collection, they compare the swim with

and without the Fastskin. Also, biomimicry has been applied to create better protections for athletes. The idea is to provide more comfort and flexibility and also keep the same level of protection or even improve it . The design process was completed following the problem driven bio-inspiration approach by working on the armadillo shell[3].

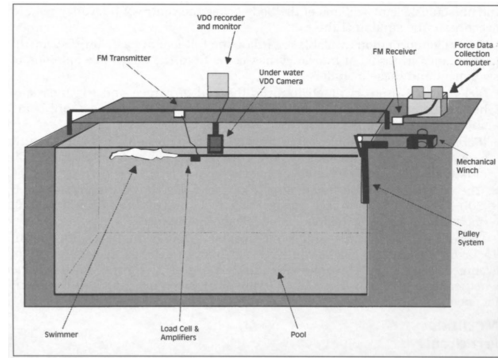


Figure 1: The towing system and drag recording apparatus

III Results

Experiences who compare standard swimsuits with Fastskin revealed that no denoting differences for hydrostatic weight ($p = 0.244$) between standard swimsuits and the Fastskin existed. However, figures below provide that the swimsuit inspired by shark skin generated 4.8% to 10.2% less hydrodynamic resistance on all drag forces summed together over towing velocities. The aerodynamic experience shows a drag coefficient value of 0.78 for an usual swimsuit and a value of 0.60 for the fastskin.

Towing Condi- tion	Normal	Fastskin™	Difference	% Diff
Surface (gild- ing)	347.9	328.6	19.3	5.5
Surface (kick- ing)	306.4	290.2	16.2	5.3
Depth (gild- ing)	296.9	266.7	30.2	10.2
Depth (kick- ing)	282.1	268.6	13.5	4.8
Overall	1233.3	1154.1	79.2	6.4

Table 1: Drag forces summed over the three towing velocities

In light of surveys about Knee protectors, the armadillo one has to deal with flexibility, comfort, injuries' protection, an easy installation and an efficient air circulation. Flexibility is based on anthropometric measurements. The new splint is based on the armadillo armour, which structure is made with elastic fiber. The use of biomimicry for the Knee protector leads to a free movements allowed product.

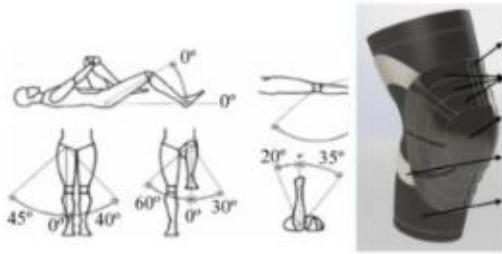


Figure 2: Knee protection movements

IV Discussion

Those results mean that biomimicry is used to improve a lot of fields. The fastskin has less hydrodynamic resistance which increases the speed of the swimmer by 5% to 10%. We found the same progress with the aerodynamic experience. Results from the survey indicate that knee protector inspired by armadillo as the best rated product that offers the best ergonomics, best movement comfort and most suitable attachment to the knee. Those experiences demonstrate that sport's innovation inspired by animals has gotten better performances. Those examples show that by studying nature

and animals, we can improve our skills and our capabilities. Such an improvement enables athletes to compete at a higher level as we saw it during the 2004 Olympics where a lot of time records were broken.

V Conclusion

The initial issue was the fact that we arrived at a point where human performances in sport reach his limit. With the search in the fastskin, results have been improved. It proves that even if the human body can reach a limit, by working on nature we can improve our capabilities to reach new records. Also, with the example of the protection, we can deduce that biomimicry can be applied to protect the human body.



Figure 3: Armadillo protection

VI Acknowledgements

We are grateful to the teams and people who work on the articles "Comparison of buoyancy, passive and net active drag forces between Fastskin™[2] and standard swimsuits", "Contribution of swimsuits to swimmer's performance"[1], "Biomimetics: forecasting the future of science, engineering, and medicine", "Bio-Inspired Approach for Innovative Design of Knee Protectors for Recreational Sports". It enables us to understand how the biomimicry works and was developed through different topics.

VII References

- [1] Hazim Moria; Harun Chowdhury; Firoz Alam; Aleksandar Subic; Alexander John Smits; Rahim Jassim; Nasser Suliman Bajaba. Contribution of swimsuits to swimmer's performance. pages 1–6, April 2010.
- [2] N Benjanuvatra; G Dawson; B.A. Blanksby; B.C. Elliott. Comparison of buoyancy, passive and net active drag forces between fastskin™ and standard swimsuits. pages 1–9, 2002.
- [3] Ana Zdravkova; Ile Mircheski; Sofija Sidorenko. Bio-inspired approach for innovative design of knee protectors for recreational sports. pages 1–6, July 2020.