HIGH-PERFORMANCE 3D-PRINTED BIONIC PROPELLER

LOWER NOISE EMISSION AND INCREASED POWER FROM A LARGE-SCALE MODEL

bigrep

BIONIC PROPELLER: NATURE INSPIRING INNOVATION

BigRep focuses on finding new applications for large-scale industrial 3D printing, and from among its team of industrial designers, architects and engineers, there are plenty of ideas to test using the BigRep ONE. Whether in pursuit of innovations in sensors, microstructures, materials or robotics, BigRep's NOWlab and creative experts seek to learn from what already exists, to create something that has never been seen before.

When product designers and engineers encounter obstacles in functional design, one approach is to look for problem-solving inspiration in nature. Over millions of years, species of plants and animals have evolved to survive the elements, fly higher, run faster, grow taller, protect themselves when vulnerable. The lessons we learn from nature can often be applied in designing industrial objects.

Botanical and zoological research provides a foundation for bionic research: drawing on elements within nature to optimize products and technologies. The research focuses on technical development using sustainable, efficient structures, patterns and builds in the natural world. In the summer of 2017, BigRep decided to explore the potential of propeller production based on bionic principles, using 3D printing technology.

"The shapes of products we know today are mostly affected by the production method," said Florian Schärfer, lead Industrial Designer on the project at BigRep. "In turn, this can really limit the functionality of objects." Schärfer explained that as computers have made it easier to calculate and implement complex structures, biological design elements can now be found in a wide field of products and simply converted into CAD files for 3D printing.

BigRep's experts are waiting to sink their teeth into your unique and challenging use case.

CLICK HERE FOR MORE INFO

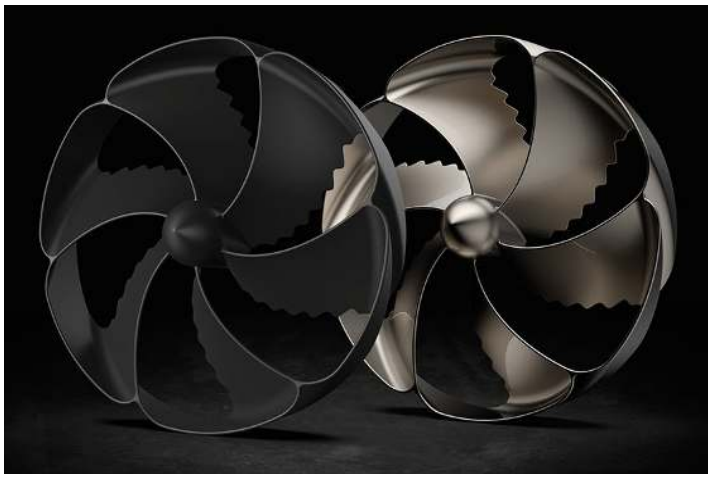
PROPELLER DESIGN PRINCIPLES

Inspired by a propeller innovation from the Technical University of Berlin (TU), BigRep developed a Bionic Propeller model that combined two key bionic research principles to make a conventional design more efficient, even more so as it was to be 3D printed.

1 The **loop ends of the propeller** are based on the pinions of bird wings, which, when splayed out, enable birds to glide with ease and low-noise emission through the air. Connecting every propeller blade through a loop creates blades with no end part.

2 The six **ridges visible on the edge of each propeller blade** are based on bumps along the fins of Humpback whales. When the propeller is rotating, air travels faster through these ridges, with less drag. The very thing that allows one of the largest mammals on Earth to move through water at seemingly incomprehensible speed, considering its weight, is an aerodynamic principle that can be applied to wind turbines and propellers.

The result is a propeller that reduces turbulence caused by air or in-water cavitation. Tests with a computer vent designed this way revealed **30% less noise emission**, and tested as a ship propeller it **raises the thrust performance by around 19%**. Like the Berlin-based researchers who developed the loop principle propeller, more and more teams of researchers are discovering and applying bionic principles that make conventional designs more efficient.



"BOTH OF THESE BIONIC PRINCIPLES WORK IN WATER AND AIR. SO, IT COULD BE ADAPTED TO SMALL VENTILATION FANS TO WIND TURBINES TO WATER OR AIR PROPELLERS."

Florian Schärfer
Industrial Designer, BigRep

CASTING THE PROPELLERS

Propeller designs are generally sand casted, and often tailor-made for a vessel or aircraft. Thus designing and casting these objects is not particularly conducive to mass production. Traditionally the positive pattern is made of wood – hand carved and sanded – then pressed with both sides into sand, creating a cavity that is filled with metal. This forms the mold, which is then filled to create the cast propeller. Then, after it has been cooled, the metal propeller is milled for the perfect finish.

The BigRep ONE revolutionizes the process of casting a propeller by shaving significant time off the production of an initial mold. "The bionic propeller model can be printed in days instead of being milled and shaped by hand over a period of weeks," said Schärfer. "The process has traditionally been laborious, but with large-scale 3D printing, the prototype can be created as one single, seamless form."

“ THE BUMPS ON THE FRONT EDGE OF THE BLADES HELP TO STRUCTURE THE FLOW LINES AND PRODUCE ADDITIONAL NOISE REDUCTION AND EFFICIENCY.”

Florian Schärfer
Industrial Designer, BigRep