

Bionik at the Technical University of Berlin



Bionik has a long tradition at the Technical University of Berlin. Based on the work of Heinrich Hertel in the 1960's, the department for "Bionik und Evolutionstechnik" has been especially set up for Prof. Dr.-Ing. Ingo Rechenberg in 1972.

Techniques and methods have been introduced which enable the extraction of the principles and active mechanisms from the analysis of the biological solutions and out of this understanding the development of prototypes. That is why a special infrastructure suited to the Bionik research has been developed for the department – with research halls, workshops

and wind tunnels, that students and doctors like to use for testing innovative Bionik approaches.

The many national and international research projects are often carried out in cooperation with industry (e.g. DaimlerChrysler, Festo, MTU, Siemens, VW). The long-standing research and teaching has been awarded with many prizes, students from all over Germany attend the lectures. The research focus lies on the theory and use of the Evolution Strategy, the Bionik of fluid dynamics, bio analogue information processing, sensory analysis, actuator technology, the systematization of Bionik and tribology.

Research and development projects

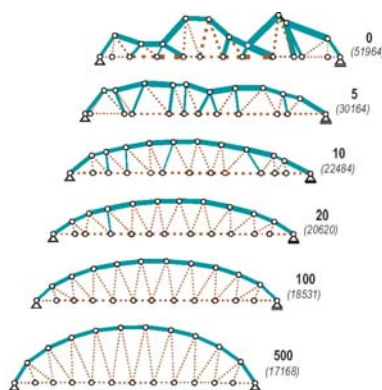
The sand skink of the Sahara Desert - An example for friction reduction and abrasion reduction

The evolution has invented cunning tricks to reduce fluid friction on fast maritime animals (e.g. dolphins skins, shark scales, fish mucus).

The sand skink of the Sahara desert swims under the loose dune sand and has, because of this, to fight very hard against sand friction. Measurements show that the microstructure surface of the sandfish scales concerning the sand friction and the abrasion resistance is clearly better than that of polished steel, glass or Teflon. Responsible for these characteristics is a regular comb structure on the scale skin of the sand skinks which is visible under an electron-scanning microscope.



Evolution à la Darwin in engineering



The Evolution Strategy has been proved as a universal tool. The mechanisms of the biological evolution have been successfully transformed into universal optimization methods and underpinned with a sound theory. The theory proves: Evolution works more efficiently than many optimization methods.

Especially the Evolution Strategy in an experiment shows great strengths in comparison to other optimization methods (noisy fitness evaluations).

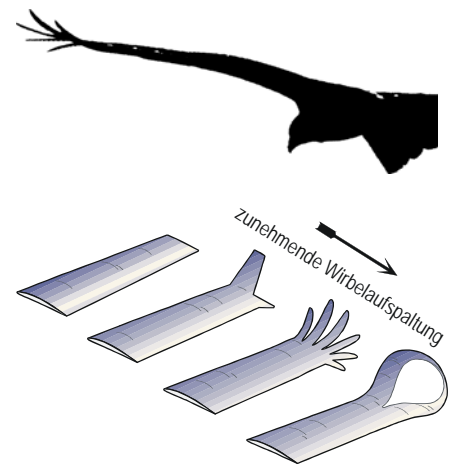
Using Darwin's evolution, aircraft wings can be optimized, fuselages can be designed, bridges constructed, telephoto lenses laid out, electronic circuits projected, neuronal networks trained and even coffee blends arranged. Engineers and computer scientists

more and more use Evolution Strategies as a universal development tool.

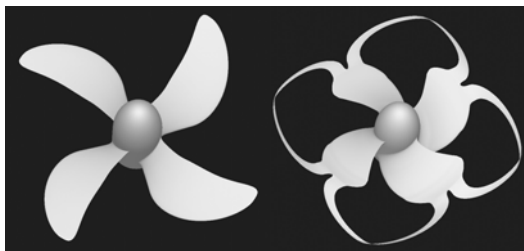
Wingtips with minimum drag

In nature and engineering different wingtips are used: land birds spread their wingtips open, to reduce the drag of the wing vortex – for airplanes mainly winglets are used. With the Evolution Strategy the optimal design of the wingtips can be established in computer simulations. The Evolution Strategy led to a new type of wingtips (Splitwing-Loops).

A vertical distribution of the unavoidable wing-tip vortex reduces the drag. Therefore Winglets (commercial aircraft), Multiwinglets (birds) or Splitwing-Loops (simulated evolution) save energy and reduce the vortex noise.



Bionik-Propeller – Energy-saving and silent



In recent years, great efforts have been made to save fuel of big container ships.

A great leap in this direction can be hoped for, if tricks from nature, that great birds use to handle vortices, can be copied. In order to fly in a most energy-saving way, storks expand their wingtips and thus reduce the harmful influence of the unavoidable wing-tip vortex. The consistent use of this knowledge on a propeller

leads to a connection of the propellertips among themselves, and thus to a reduction of the wing-tip vortex losses without loss of stability.

Anthropomorphic muscle robot – adaptive men-machine interaction

From a technical point of view the human being in his constitution and motions is still unattainable today.

The “Zwei-Arm-Roboter” ZAR is the first robot which is like the human being concerning its morphology and physiology. It is full of Bionik solutions. Not only the construction of the limbs and joints, but also the realization of the actuators with artificial muscles, underlines the consequent conversion of Bionik ways of thinking and acting. All functions of the human hand-arm-combination have been transferred onto ZAR, without disregarding the technical realisability at the same time. The humanoid muscle robot is a joint project of the TU Berlin with the companies Evologics and FESTO.



Teachings

The following teaching sessions can be chosen at the TU Berlin:

- Lectures:** Bionik I, II and Evolution Strategy I, II
- Labs:** Bionik-Lab I, II und Evolution Strategy Lab I, II
- Seminar:** Selected chapters of Bionik and Evolution Techniques.

Contact us

Please do not hesitate to contact us for further questions:

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