Media communiqué

Materials Science & Technology

Duebendorf, St. Gall, Thun, 26th May 2009

New fields of application for lightweight construction elements

Lightweight wings for a high-flying kite

Tensairity elements made of air filled membrane assemblies, rods and cables have already made a name for themselves in the construction world as extremely light yet strong load-bearing structures. But is this new technology also suitable for use in the aerospace industry, for example to create novel wings for kites? Empa researchers are currently pushing back the envelope in this field, and are also demonstrating their first flying models.

Ultra light wing structures for kites are not just attractive for sport and hobby users but are also of interest to engineers, for example in applications such as towing kites which take advantage of wind energy to provide additional propulsion for diesel powered freighters, pulling them across the oceans. In this case the kites are intended to help shipping concerns to reduce their high fuels costs. They can also be used for other applications involving the exploitation of wind energy, one idea being to allow a kite to climb to a height of several kilometers, while up pulling a line wound around a drum. As the drum rotates to pay out the line, it can be made to generate electricity. When it reaches its target altitude the kite's wing-area is somewhat reduced causing it to descend, following which it begins a new climb phase and once again generates electric power. This is a fascinating field of application for ultra light structures, because in order for the kite to utilize the wind's energy efficiently it must have a large wing area.

Exploring the limits

Rolf Luchsinger, head of Empa's «Center for Synergetic Structures», and his team wanted to make use of a demonstrator device to find out where, from an aeronautical point of view, the limits of the technology lie, and whether a Tensairity kite would offer any particular advantages. Brainstorming together, Luchsinger and a member of his group who had previously studied aerospace engineering came up with several ideas for suitable shapes and sizes. Based on these ideas a series of models were developed with steadily improved aerodynamic and static characteristics, shown by laboratory tests and computer simulations. The slimmer and more stable the air-filled wing spars, the more efficiently the kite climbs and therefore the better its pulling power can be harnessed to generate electricity.

The biggest Tensairity kite which Luchsinger's team has developed so far has a span of 8 meters and a surface area of 11 square meters, and has undergone numerous load tests in the laboratory. With a weight of 2.5 kilograms it is designed to generate a tensile force of 1000 Newtons, and could in theory climb to an altitude of 4000 meters.

Flight testing under the open sky

After the extended design phase and subsequent construction of the demonstrator kite, the researchers were keen to try out their baby. How high would it climb to? Would it generate the calculated amount of power? And – not to be forgotten – would it return to earth in one piece after its maiden flight? The first tests under the open sky made by the Empa scientists were at a disused military airfield in the Bernese Oberland, where the kite was towed behind a car at a height of 50 meters along a one kilometer long course. Luchsinger was happy with the outcome of this initial trial. “Our system works, the Tensairity kite is capable of generating the power we expected.” Now the researchers are already thinking about their next vision – a kite with a span of up to 30 meters whose internal structures are filled with helium, so that even if the wind dies it would still stay aloft.

The novel wing concept is not just suitable for making kites, however. It shows potential for applications in sports and in the unmanned aerospace field. It could also conceivably be used as a communication platform. In this conceptual application a kite platform (HAPS, «High Altitude Platform System») flying at great altitude would act as a relay station for radio and telephony signals instead of a satellite.

Further information

Dr. Rolf Luchsinger, Empa Center for Synergetic Structures, Tel. +41 44 823 40 90, rolf.luchsinger@empa.ch

Editor / Media contact

Martina Peter, Empa Communication Dept., Tel. +41 44 823 49 87, redaktion@empa.ch

TheTensairity kite undergoing load tests in the laboratory.

The Tensairity kite during towing tests at Duebendorf airfield

The Tensairity kite after successfully completing its towing trials in the Bernese alps.

The images at suitable resolution and the text in electronic form are available from redaktion@empa.ch