Heli-trainer Sets New Standards in Pilot Training

Heli Aviation GmbH, KUKA Roboter GmbH and the Max Planck Institute for Biological Cybernetics joined forces at this year's ILA, the leading international trade fair for the aviation industry, to present a joint concept for a new type of helicopter flight trainer.

The four- to six-meter-high Heli-trainer flight simulator can be controlled with a joystick.

Photo: Jo Teichmann

The goal of this joint development project is to create a realistic system that makes it possible to train pilots safely, effectively and economically. Unlike normal flying lessons, critical maneuvers can be repeated often and simulated to the point of crashing – without the attendant consequences. In practical training, instructors are compelled to intervene immediately when their pupils make an error. With the aid of the Heli-trainer, it doesn't take long for would-be pilots to develop a feel for the required movements and gain a better understanding of the consequences of pilot error, as well as learning to maneuver in a safe environment with a steep learning curve.

One of the biggest technical challenges in developing such a trainer is the need to replicate the movements of complex real-life systems in a minimum of space in such a way that the pilot actually has the feeling of flying a real aircraft. The KUKA model KR 500 TÜV robot, modified by the Max Planck Institute for Biological Cybernetics to be a motion simulator, is a heavy-duty robot with an attached helicopter cell in which one or two persons can practice realistic helicopter maneuvers.

Paradigm Shift in Tumor Treatment

Individual tumors differ substantially in their mutation profiles, even when they are produced by the same type of cancer. That's why, in 2008, the International Cancer Genome Consortium (ICGC) was formed to create a comprehensive catalog of the genetic changes in tumors.

The organization currently encompasses 22 countries worldwide. Their goal is to provide predictive molecular markers for every individual type of tumor and every patient. This will enable doctors to avoid ineffective treatments and decide on the most appropriate, risk-aware therapy in every case, as well as supporting the search for new forms of treatment. At the beginning of 2010, German scientists, including the group headed by Hans Lehrach at the Max Planck Institute for Molecular Genetics in Berlin, initiated the joint Pediatric Brain Tumors project, which is coordinated by the German Cancer Research Center in Heidelberg. Brain tumors, which are diagnosed more than 300 times a year in Germany, are the main cause of cancer mortality in childhood. The German Federal Ministry for Education and Research and the aid organization Deutsche Krebshilfe e. V. are contributing 15 million euros over a 5-year period to support Germany's participation in the ICGC.

"The goal is to create a designer microbe"

In May 2010, Craig Venter announced the creation of the first "synthetic cell." His team succeeded in reconstructing the genome of the bacteria *Mycoplasma mycoides* piece by piece in the laboratory and transplanting it into the cell of another type of bacteria. In an interview, Ralph Bock of the Max Planck Institute for Molecular Plant Physiology gave us his thoughts on the results.

What is so special about Venter's current work? Scientists have been transplanting genetic material from one cell to another for years in cloning experiments.

Ralph Bock: That's right. But in cloning, the whole cell nucleus is transplanted into an egg cell from which the original nucleus was removed. So it is not just genes that are transferred, but proteins and enzymes as well. Venter has shown that transplanted DNA on its own can reprogram a cell. But what is really new is that, for the first time, the genes of a living organism have been manufactured entirely in the laboratory. To achieve this, the genetic sequence must first be precisely decoded and the DNA strand then assembled piece by piece. That is a huge achievement when you consider that the genome of this bacterium consists of more than a million components. One wrong component can result in the incorrect reading of a vital gene, meaning that the whole genome will fail. That's what happened in this current work: the team spent three months looking for one missing base pair – one in a million!

What significance do these results have for research?

Ralph Bock: From a scientific point of view, the results were to be expected. Few scientists ever doubted that a correctly synthesized genome would work if it were introduced into a new cell. But it hadn't ever been demonstrated experimentally. What's more important is that, with the methods Venter's team developed, we will soon be able to study genes more rapidly and on a larger scale, and modify them more efficiently than in the past.

Venter's experiments are being described as synthetic biology. What are they intended to discover?

Ralph Bock: The goal is to modify genetic material in such away that its host acquires the desired capabilities. For instance, bacteria that produce active ingredients for drugs in large quantities – so a kind of designer microbe. In the same way, we could also create a minimized version of the genome. We still don't know which genes an organism absolutely must have in order to live, and which ones it can live without. We still need to learn a lot more about how genes are regulated and how they influence one another – an important aspect of another modern area of the biosciences known as systems biology.

Are Venter's results transferable to other organisms? Is it conceivable that human DNA could be manufactured in the laboratory and transplanted into a cell?

Ralph Bock: Not in the foreseeable future. One problem is the size of the genome: it wasn't by chance that Venter picked a bacterium that has one of the smallest known genomes in the living world. By comparison, human DNA consists of 3,000 times more components. Decoding and re-synthesizing genomes of that order is not yet technically possible. Moreover, the "design plan" of animals and plants is not limited to just the sequence of DNA building blocks. Both these building blocks themselves and the proteins that surround the DNA can be chemically altered and regulated. In bacteria, such epigenetic changes are of little importance. Synthetic plant or animal cells, however, would have to contain all of the epigenetic changes at the correct points – and we are decades away from doing that.

Nevertheless, critics are accusing Venter of playing God and creating artificial life.

Ralph Bock: That's an exaggeration. Venter and his colleagues have synthesized genetic material, but they implanted it in a natural bacteria cell. So ultimately, only a tiny, albeit central, part of the new cell originated in the laboratory. To qualify as artificial life, the whole hardware of the cell would have to be made in the laboratory, its protein and energy factories, or maybe the membranes with all their transport systems for absorption and secretion. We are talking here of tens of thousands of components that would have to be synthesized and correctly positioned to make a completely artificial cell.

Ralph Bock

Is that even conceivable?

Ralph Bock: It is certainly conceivable, but very, very difficult, of course. Fats, sugars and amino acids could still be manufactured relatively simply, but synthesizing larger proteins is much harder work. At present, large macromolecular complexes can't be manufactured at all by purely chemical means. In my opinion, in this respect, too, we are still decades away from creating a completely artificial cell.

One of the accusations concerns the patents that Venter filed for his discoveries. Could these hinder further research?

Ralph Bock: Such patents generally come into play only when third parties want to use the new technology commercially. They have no substantial impact on basic research.

What ethical questions do the results raise?

Ralph Bock: At the present time, in my opinion, none, because the boundaries between traditional genetic engineering and synthetic biology are fluid anyway. We have been adding new genes to the genetic make-up of cells or disabling existing ones for more than 20 years. Even the use of chemically synthesized genes has been part of the standard genetic engineering repertoire for years. Many of the pharmaceutical drugs used today are already produced by such genetically modified microorganisms. Venter has now broadened the field of possibilities with which we may soon analyze and specifically modify the building plan of life – nothing less, but nothing more either.

Photo: Private

80 Million Euros for Stem Cell Research

Münster is to be the home of a new reference center named CARE – the Center for Applied Regenerative Engineering

Thomas Sternberg (CDU, member of the NRW state parliament), Hans Schöler, Annette Schavan and Jürgen Rüttgers (left to right)

Few, if any, areas of research have developed as dynamically in recent years as iPS technology. With the aid of simple tricks, researchers can restore mature body cells to a pluripotent state in which – like embryonic stem cells – they can once again form all of the more than 200 cell types that make up the body. The method by which these so-called induced pluripotent stem cells (iPS cells) are manufactured has been considerably simplified since it was first established in 2006. The Max Planck Institute for Molecular Biomedicine in Münster has made a substantial contribution to these advances and now intends, in cooperation with the new reference center, to devote its attention specifically to developing and refining iPS technology. The reference center provides a basis for strategic cooperation, as well as a methodological platform for the ongoing development and marketing of iPS cell technology itself and the resulting products. Of the 80 million euros in start-up funding, 75 percent will be provided by the state of North Rhine-Westphalia, with the Federal Ministry of Education and Research (BMBF) contributing the remaining 25 percent.

MaxPlanckResearch Prize Awarded

The MaxPlanckResearch Prize, endowed with 750,000 euros, has been awarded to Timothy George Bromage of the New York University College of Dentistry and Michael Tomasello of the Max Planck Institute for Evolutionary Anthropology in Leipzig. "The Alexander von Humboldt Foundation and the Max Planck Society wish to recognize two scientists who have made a significant contribution to improving our understanding of the evolution of mankind," said Max Planck Society President Peter Gruss at the award ceremony. Michael Tomasello is studying the origins of language and the cultural evolution of humans. In empirical studies of small children and primates, he is researching the cognitive abilities that distinguish man from other highly developed primates. Timothy Bromage is investigating what can be learned about the living conditions of early man from the structure of bones and teeth. Among other findings, he has discovered how to decipher the speed of growth and individual life histories of early humans from the structure of their bones. The MaxPlanckResearch Prize is funded by the German Ministry of Education and Research. Secretary of State Cornelia Quennet-Thielen presented the awards at an event hosted by TV journalist Kristina zur Mühlen at the Hanover Congress Center. The prize is given each year to two scientists of international renown – one working in Germany and one working abroad – and is intended to enable them to pursue their work through the medium of international cooperation.

Peter Gruss, Michael Tomasello, Timothy Bromage, Cornelia Quennet-Thielen, Helmut Schwarz and Kristina zur Mühlen (left to right)

Two Max Planck Centers Planned for South Korea

Max Planck Society scientists are expanding their cooperation with South Korean colleagues at the private Pohang University of Science and Technology (POSTECH). Max Planck President Peter Gruss and the President of POSTECH, Sunggi Baik, signed an agreement in Munich on June 14 for a research initiative that will initially lead to the establishment of two international Max Planck Centers in the fields of attosecond science and complex phase materials. Scientists from both institutions are already working together in these fields. The new centers will allow them to accelerate the interchange of expertise and personnel, and support the joint training of junior researchers.

Photos: MPI for Molecular Biomedicine (top), Janina Snatzke

"Jugend forscht" – National Awards Presented

The winners of the 45th national "Jugend forscht" competition recently received their awards in Essen. Ferdi Schüth, Director at the Max Planck Institute for Coal Research in Mülheim, congratulated the winning trio in the biology category: Florian Schreier, Thomas Irion and Lukas Dieterle impressed the jury with their work on the schooling behavior of fish. At the invitation of the EU, they will now travel to the 22nd European Union Contest for Young Scientists in Lisbon. The three budding researchers from Baden-Württemberg analyzed the schooling behavior of various species of fish before developing a simulation program with a virtual school of fish whose behavior corresponds closely with that of their real-life counterparts.

Ferdi Schüth with the three biology winners Lukas Dieterle, Florian Schreier and Thomas Irion (left to right).

Photo: Jugend forscht

Meet Us On Facebook

For a little while now the Max Planck Society has had its own page on Facebook. With more than 400 million active users, around half of whom visit the site daily, Facebook is the leader among social networks. The users who meet here are mainly young people who are keen to share their experiences – for example about studying abroad and the trendiest places in town. We want to explore the potential of such community platforms as a venue for corporate communication. Right now, the number of users in direct contact with the Max Planck Society is still modest – our page currently has around 900 followers. The more the merrier!

On the Net

Cell Rejuvenation
At the Max Planck Institute for Molecular Biomedicine in Münster, Hans Schöler succeeded in turning back the clock just by adding a single factor, oct4, to neuronal adult stem cells: they develop into pluripotent cells, the all-rounders on which the hopes for regenerative medicine rest. To watch a German-language animated film showing how pluripotent stem cells can become a source of natural replacement tissue, offering a possible treatment for diseases such as Parkinson's, visit:
http://www.filme.mpg.de

Completely Complex
Sabine Sütterlin is a freelance science journalist. Since June of this year she has been reporting on her "field studies at the three Max Planck institutes in Dresden, where researchers are exploring complex systems and molecular processes in cells and solids." In her blog entitled "Completely Complex" (in German), she displays a sense of humor and a gift for observation as she describes such topics as chaperones that whip proteins into shape and fruit fly embryos that turn into movie stars:
http://www.scienceblogs.de/komplett-komplex/

On the Fascination of Black Holes
In her day job, Annalie is a musician. However, she is also the daughter of Bernard Schutz, Director at the Max Planck Institute for Gravitational Physics in Golm. That is why Annalie now finds herself interviewing leading astronomers and asking, in a refreshingly natural way, what it is that fascinates them about black holes. The resulting 15 videos prefaced by a snappy trailer are aimed at a younger audience. A further 10 episodes about gravitational waves are set to follow:
http://www.scienceface.org/