Nearly 10 million euros ($13.6 million) in ERC grants for 6 Technische Universitaet Muenchen researchers

EurekAlert

Six top scientists of the Technische Universitaet Muenchen (TUM) have been awarded prestigious ERC Grants: ?1.5 million goes to Prof. Stephan A. Sieber for the development of drugs to combat multi-resistant germs; Prof. Hendrik Dietz receives ?1.5 million to study interactions between cellular components; ?1.6 million goes to Prof. Andrzej Buras, who wants to develop a basic theory on elementary particles; Prof. Daniel Cremers (?1.98 million) is working on better algorithms for image processing; Prof. Karl-Ludwig Laugwitz (?1.8 million) aims to explain the causes of a hereditary heart disease; and Prof. Eckehard Steinbach (?1.5 million) wants to improve data communication for remotely controlled robots.

Drugs for Fighting Multi-Resistant Bacteria

Infectious diseases have experienced a dangerous renaissance in recent years. Multi-resistant germs have emerged from the imprudent administration of antibiotics. Some pathogens, such as the multi-resistant Staphylococcus aureus (MRSA), cannot be fought with existing antibiotics. This has had dramatic consequences for treatment and has lead to a sharp increase in deaths worldwide. A central research goal is thus to develop new and effective therapies against MRSA and other pathogens. The Sieber team has already been able to establish a new agent in this field. It weakens the bacteria in their pathogenicity and virulence, making the disease easier to treat. The ERC grant has now given rise to wholly new perspectives in the identification of additional agents and has opened an investigation into the molecular basis of infectious diseases. The analytics will be a central focus through the help of which new, nature-derived substances can be tested for their potential therapeutic effect against multi-resistant germs. These research results should ultimately lead to more effective therapies and a better understanding of bacterial virulence and its treatment.

Prof. Stephan A. Sieber is Chair of Organic Chemistry II for the Department of Chemistry at TUM and is a member of the Excellence Cluster "Center for Integrated Protein Science Munich" (CIPSM). He is also the founder of AVIRU, a spin-off company funded by the Exist Program of the Federal Ministry of Economics and Technology, the research findings of which are further developed for medical application. Prof. Sieber receives an ERC Starting Independent Researcher Grant.

The Origin of Life

A bacterium such as Escherichia coli contains about 5,000 different protein molecules. Overall, the organism is composed of about five million protein molecules. Taken alone, each of these molecules is dead matter. Only through the

interaction of proteins in a confined space, such as a cell, can a viable system result. Thereby, proteins are permanently modified through reversible interactions with genetic molecules, such as DNA and RNA, or with other protein molecules. Food is decomposed into usable pieces from which new cell components are built until the cell can divide and a new organism emerges. A stated goal of modern systems biology is to identify and characterize the complete set of these interactions. Of interest here are, among other things, the binding strength and the reaction rates for the binding and dissolution of contacts between molecules.

Prof. Hendik Dietz is Professor of Biophysics at TUM; a Hans Fischer Tenure Track Fellow with the Institute for Advanced Study at TUM; and a member of the Excellence Cluster "Center for Integrated Protein Science Munich" (CIPSM). Prof. Dietz would like to use the the ERC Grant to develop new methodological approaches for the study of these interactions so that they can be examined more quickly and in more detail. Prof. Dietz receives an ERC Starting Independent Researcher Grant.

The Flavor of Leptons

Prof. Andrzej Buras would like to develop a basic theory of so-called flavor physics as part of his project. In flavor physics, the fundamental properties of elementary particles, quarks and leptons, are investigated. In total, there are six quarks and six leptons with different characteristics in terms of electrical charge and flavors, for example, the up and down quarks. An accurate understanding of the flavor structure of quarks and leptons, their masses, and interactions is still pending. The aim of Professor Buras and his team is to decipher these unknown structures in order to ultimately better understand the development of the early universe.

Flavor physics is one of seven key research areas of the Universe Cluster. In this project, future results of flavor experiments at the Large Hadron Collider at CERN in Geneva and the Belle II experiment in Japan (KEK) will also play a role. Both of these institutions are cooperative partners of the Universe Cluster.

Prof. Andrzej Buras is Professor of Theoretical Elementary Particle Physics at TUM and Head of the Research Division for the Excellence Cluster "Origin and Structure of the Universe" at TUM. Since 2007, Buras is also a Carl-von-Linde Senior Fellow at TUM's Institute for Advanced Study (TUM-IAS). He is considered one of the world's leading scientists in applied quantum field theory. Prof. Buras receives an ERC Advanced Investigators Grant.

Optimization Methods for Image Processing

Digital cameras and their images accompany our daily lives in many different ways. Computer-based information extraction from images, however, is one of the biggest challenges in computer science. From the reconstruction of three-dimensional objects by analyzing two-dimensional images -- via face and facial expression recognition, for example -- to the analysis of complete scenes, there are a variety of tasks for which quick calculation methods are required.

Prof. Daniel Cremers is Chair of Intelligent Autonomous Systems for the Faculty of Computer Science at TUM. In the project "Convex Optimization Methods for Computer Vision and Image Analysis," optimization methods will be developed for evaluating a variety of problems in computer vision and image analysis. A particular focus is on convex optimization methods and polynomial algorithms in order to identify the most versatile practical solutions with the shortest possible processing times. Prof. Cremers receives an ERC Starting Independent Researcher Grant.

How a Sick Heart Develops

Among congenital heart defects, the Tetralogy of Fallot is one of the most prevalent severe cardiac diseases. The heart is here malformed in four places so that it cannot function properly. As a result, the lungs receive decreased blood flow, and the body is not adequately supplied with oxygen. In severe forms only an operation during infancy can help. Although the disease has been characterized for over 100 years, scientists have only recently begun to understand the causes. Evidently, a specific group of cells malfunctions during embryonic heart development. With funding from the ERC Starting Grant, Prof. Karl-Ludwig Laugwitz will examine which components of the molecular regulation mechanism of these cardiac precursor cells are defective. The scientific team led by Prof. Laugwitz will gather connective tissue cells from the skin of Tetralogy of Fallot patients (who were operated on during childhood) and re-program these into pluripotent stem cells. These cells have characteristics similar to embryonic stem cells. From these, cardiac precursor cells and mature cells of the cardiovascular system can grow, enabling a study of the molecular mechanisms of heart development. The researchers hope to gain new insights in cardiovascular stem cell biology and use these for future regenerative therapies and tissue replacement in cardiology.

Prof. Karl-Ludwig Laugwitz was appointed to the Associate Professorship W2 of Cardiology at TUM's university hospital "Rechts der Isar" in 2005. He also works as a senior physician at the German Heart Center Munich and is a recognized expert in the molecular signaling of embryonic heart development and in cardiovascular stem cell biology. Prof. Laugwitz is the spokesperson for the Multicenter Research Group 923 "Molecular Analysis of Cardiovascular Functions" (funded by the German Research Foundation) and in 2006 won the Marie Curie Excellence Team Grant, a prestigious research prize valued at ?1.6 million. Prof. Laugwitz receives an ERC Starting Independent Researcher Grant.

Feel like a Robot

Robots of the future will see more, hear more, and even feel more. Using a telepresence system, a person can take on the role of a robot. While the person teleoperates, he will not only see and hear what the robotic sensors pick up but will also feel. There has to be a transmission of the so-called haptic sensor data between human and teleoperator.

In order for this vision of realistic telepresence to become reality, the communication between the user and the remotely controlled robot must be improved. A major challenge here is the transfer of haptic sensor data over the

Internet. This requires clever coding: Since either transission delays or lost information could negatively affect the sense of reality, the data must be compressed and communicated in a way that ensures both speed and quality.

With the ERC Starting Grant, the team will develop the Prof. Eckehard Steinbach Method for haptic data communication, which carefully manages the limits of human perception similar to MP3 for audio. Application scenarios arise whenever the teleoperator is far away or the distant environment is dangerous, inaccessible, or significantly scaled down. Possible operational fields include the remote-controlling of service robots in space, minimally invasive surgery across long distances, and the assembly of small parts in manufacturing engineering. In recent years, essential preparatory work for the ERC Grant has been developed in a project funded by the Deutsche Forschungsgemeinschaft (DFG) Collaborative Research Center (SFB 453).

Prof. Eckehard Steinbach is Chair of Media Technology for the Department of Electrical Engineering at TUM. With his team, which currently consists of 20 doctoral and post-doctoral researchers, he explores methods for high-quality, resource-efficient, and user-centric multimedia communications. Prof. Steinbach receives an ERC Starting Independent Researcher Grant.

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