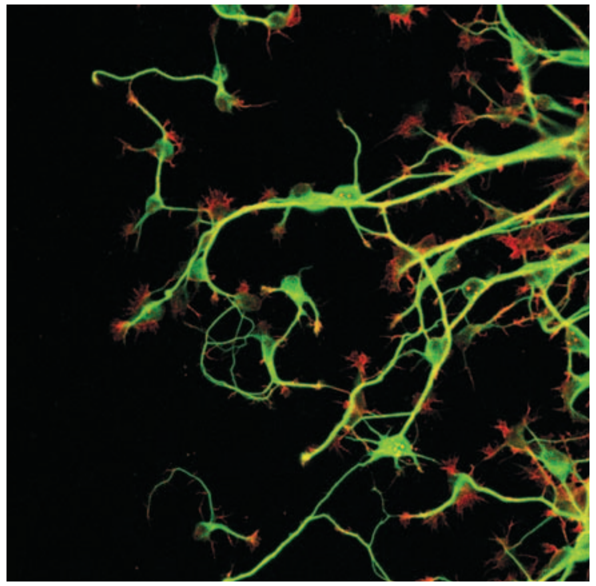
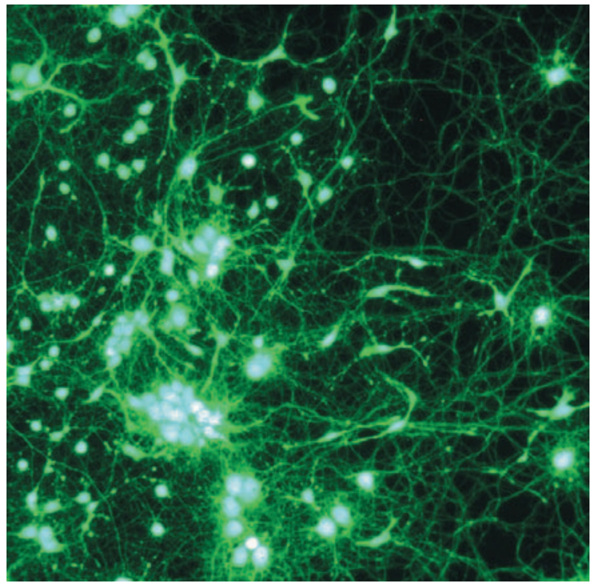




Brain neurons magnified by a scanning electron microscope (SEM)

Solutions for the Future of Neurotherapy

Philips Research hosts leading researchers at a neurotherapy symposium

In June, Philips Research in Eindhoven hosted a ground breaking symposium about the challenges and opportunities in the diverse and complex area of neurotherapy. Keynote speakers provided insight into pain management, neurorehabilitation, and perhaps most significantly, brain stimulation treatments. The following workshops identified potential research subjects. The chief organizer of the symposium and Principal Scientist at Philips Research in Eindhoven, Prof. Dr. Ir. Michel Decré, ended the symposium with a perspective on the future of brain stimulation.

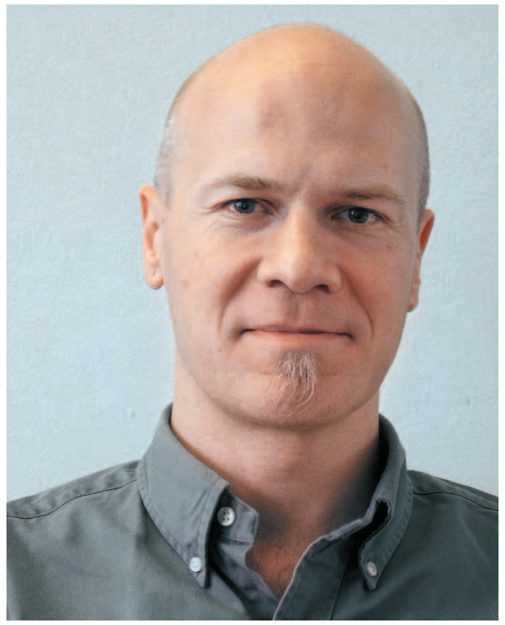
Current techniques in brain stimulation

Various brain stimulation techniques try to reduce neurological symptoms by applying electrical impulses to the brain. Deep Brain Stimulation (DBS), which implants a "brain pacemaker", and Vagus Nerve Stimulation (VNS), for example are already FDA approved treatments for Parkinson's disease and epilepsy, respectively. Clinical research is looking into new indications, such as depression. Imaging and monitoring of treatments are high on the agenda for the future of brain stimulation. During the symposium, Prof. Benabid – keynote speaker on deep brain stimulation – identified the most significant opportunities for improvements in localization, biosensing and correct positioning of electrodes in the brain. The best electrode position means optimal patient improvement, so imaging for target identification, trajectory planning for implantation and intraoperative control of placement is important in achieving better outcomes. Prof. Benabid also mentioned multipositionable electrodes as desirable to more accurately adapt to the spatial distribution of stimulation to the specific functional somatotopy of each patient.

Challenges and opportunities

The associated workshop sessions underlined the opportunities in planning, tracking and guiding interventions in neurosurgery. MRI compatible devices, increased spatial resolution for implant placement and merged modalities (supported by the right software) will be needed to offer a comprehensive solution. But it is not only DBS that would benefit from improved imaging solutions. Transcranial Magnetic Stimulation (TMS), a non-invasive method that uses powerful, rapidly changing magnetic fields to induce electric fields in the brain, would also greatly benefit from targeting improvement and new methods to reach deeper brain structures.

To a large extent, the accuracy of stimulation targeting depends on understanding the exact functional structure of the individual patient's brain. This means imaging suppliers must collaborate more closely with researchers working on brain-mapping and functional networks. The goal would be to create a "4D" brain mapping solution that can be used interactively in neurosurgery. This would start with functional and diffusion-tensor MR, SPECT and PET technologies. This is already technically possible, but making it feasible remains a challenge of standardizing software to seamlessly blend brain imaging, mapping, and modeling. In the longer term, these imaging technologies will also need to work with – and benefit from – advances in molecular imaging.



Prof. Dr. Ir. Michel Decré, Principal Scientist,
Healthcare Devices and Instrumentation Department

Another expectation is that Clinical Decision Support Systems (CDSS) for neurostimulation therapies will become available in the next five to ten years. These will depend on neurostimulation becoming a more widely accepted, evidence-based medical practice, that is, as targeting, implantation and stimulation parameters become better documented and more accurate, universal and standardized. Such CDSS's will help reduce the time taken to make decisions, thus improving average patient outcomes and bringing down the costs of treatment.

A further exciting prospect identified at the symposium is technology to stimulate the brain only as necessary – so-called "closed loop" stimulation. Most research groups and neurotech companies in this field are gearing their current work to offering neuroprostheses for patients suffering from post-stroke neurological impairment, traumatic brain injury, or spinal cord injury. Advances depend on gaining insights into the inner workings of in vivo neural circuits. Progress is slow, but as the expertise increases, other neurological indications, such as epilepsy, may also benefit from "closed-loop" brain stimulation.

A vision for the future

In the long term, a wider definition of brain stimulation could play a role for novel, curative therapies. Prof. Decré commented, "As we progressively get to know more about neurons and how to influence their function, we can develop more organic brain stimulation techniques, as opposed to the current electrical or systemic drug solutions." These will make it possible to detect and control neuronal dysfunctions by probing, influencing or controlling the relevant cells in the brain at the protein level.

The science of brain stimulation will therefore become more proactive than the current passive, "switch-off" approaches. It will at the same time be miniaturized and more integrated, with microsystems delivering specific therapies to their specific targets, making the best combined use of drug, genetic, protein-based or physical (for example, electromagnetic) approaches. This is how brain stimulation will claim its legitimate place in the neurotherapeutic arsenal. <