Industry Corner

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In this "Industry Corner" column, we interview Dr. Christoph Guger, the founder and CEO of g.tec medical engineering GmbH.

Dr. Guger studied electrical and biomedical engineering at the University of Technology Graz in Austria and at Johns Hopkins University in the USA and received his PhD in 1999. In 1999, he founded g.tec, a company which now has branches in Austria, Spain, USA, Canada, Japan, and Hong Kong. g.tec produces high-quality neurotechnology and real-time brain computer interfaces for the research, medical, and consumer markets. The company is active in many international research projects in the following domains: brain-computer interfaces, neuromodulation, stroke rehabilitation, assessment and communication with patients with disorders of consciousness, and high-gamma mapping in epilepsy and tumor patients.

In this interview, Dr. Guger will share his vision for the future of brain-computer interfaces (BCI) and neurotechnologies, discuss some open research problems and existing challenges, how academia-university partnerships can help tackle these challenges, and, lastly, provide some advice for young researchers wishing to enter the fields of BCI and neurotechnology. We hope you enjoy the interview!

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1. Could you share a bit about your background and how you found yourself working in the field of brain-computer interface (BCI) & neurotechnology? What aspects of this area do you find most fascinating and ground breaking?

My journey into brain-computer interface (BCI) and neurotechnology began with a strong interest in understanding how the brain works and how we can extract meaningful information from it. I've always known I wanted to start my own company—my parents ran a business, and that spirit of entrepreneurship shaped me early on. I was deciding between working on wind power plants or BCI systems. Eventually, I chose BCI because of its scientific depth, massive potential for impact, and the fact that it's far less entangled in political and regulatory roadblocks compared to the energy sector.

I founded **g.tec medical engineering** in 1999 with the goal of building tools that allow researchers, clinicians, and developers to access brain signals in real time and translate them into action. What fascinates me the most about this field is how quickly technology and neuroscience are converging to restore function, communication, and independence for people who were once considered unreachable—such as those with locked-in syndrome, stroke, or severe neurological injuries.

BCI is one of the few fields where you can witness a direct interface between thought and action, where brain signals can control prosthetics, computers, or even exoskeletons. It's groundbreaking because it redefines human-machine interaction and gives hope where traditional medicine reaches its limits. Watching a patient move their hand or communicate just by thinking—this still amazes me every time.

2. Please tell us a bit more about your research and g.tec medical engineering and how they are helping push BCI research in directions others have overlooked.

At g.tec medical engineering, we've spent the last 25 years pioneering hardware and software solutions that enable real-time access to the human brain. Our core mission is to create medical-grade, high-performance brain-computer interface (BCI) and neurotechnology systems that are flexible enough for research, yet robust and reliable enough for clinical use.

What sets us apart is our focus on turning fundamental neuroscience into real-world solutions. We don't just build devices—we build ecosystems: amplifiers, signal processing software, neurorehabilitation systems, invasive and non-invasive BCI platforms, and toolkits for Python and Unity development. This allows our technology to be used in everything from neurosurgical planning and brain assessment in disorders of consciousness, to stroke rehabilitation, speech neuroprosthetics, and human-robot interaction.

We've also invested heavily in high-resolution systems, like our g.Pangolin with 1024 channels, which goes far beyond the standard 64-channel systems most researchers use. This opens up possibilities for mapping brain function at a level previously achievable only with invasive electrodes.

In terms of pushing the field in new directions, we've introduced the recoveriX system, which uses a combination of motor imagery, visual feedback, and electrical stimulation to restore movement in stroke, MS, and Parkinson's patients—even decades after injury. Our cortiQ platform enables real-time functional mapping during neurosurgery, helping remove tumors while preserving critical cognitive functions.

Beyond the tech, we help drive the global BCI community forward with initiatives like the BCI Award, the BCI & Neurotechnology Spring School, and the BR41N.IO Hackathon Series, which are now some of the largest and most influential gatherings in the field. We are committed to building bridges between labs, clinicians, developers, and even artists to ensure that BCI becomes a truly interdisciplinary revolution.

In short, g.tec is not just following BCI trends—we're helping to define what's possible next.

3. Which, would you say, are the hottest research topics in this area, today and for the next five years? Can you give some examples of some open research problems?

Today, some of the hottest research topics in brain-computer interfaces (BCIs) and neurotechnology revolve around some key areas, such as restorative BCIs, high-resolution brain mapping, and real-world usability. Some topics are listed below, which are not only technologically fascinating, but they're also closely tied to clinical impact and societal relevance.

1. Bidirectional BCIs – BCIs are moving from simple signal decoding to full sensorimotor loops. Systems are now being designed to not only decode motor intentions, but also deliver artificial sensory feedback via electrical or vibrotactile stimulation. This is crucial for applications like

restoring movement in tetraplegic patients or developing more natural control of prosthetic limbs. However, challenges remain in timing, signal integration, and personalization.

2. Non-invasive speech decoding – Enabling people to communicate purely via thought is a long-standing goal. We're seeing progress in speech perception and production BCIs, but current systems either rely on invasive methods or lack robustness for daily use. Making non-invasive speech neuroprosthetics fast, accurate, and trainable within minutes is a major open problem.
3. Ultra-high-density EEG and ECoG – Devices like our 1024-channel g.Pangolin or stereo-EEG arrays with real-time high-gamma mapping are pushing the spatial and temporal resolution of neuroimaging. But how much resolution is enough, and how can we process this data efficiently in real time? This raises important questions about data compression, interpretability, and hardware scalability.
4. BCIs for Disorders of Consciousness (DOC) – Understanding covert awareness in unresponsive patients and providing brain-based communication remains a high-impact and ethically charged field. Systems like mindBEAGLE show promise, but challenges include standardizing assessment protocols and handling individual variability in EEG signals.
5. AI and adaptive learning in BCI – Personalized BCIs that adapt over time using machine learning are key to long-term usability. But avoiding bias, ensuring explainability, and dealing with non-stationary EEG signals are still major research challenges.
6. Neuroethics and regulation – As BCIs transition into everyday applications (in healthcare, education, gaming, and even defense), there is an urgent need to address data privacy, cognitive liberty, and standardization. Research here must go hand-in-hand with technical development.

Looking forward, the integration of BCI with AR/VR, brain-to-brain communication, mental state prediction, and closed-loop brain stimulation therapies are exciting frontiers. But we still lack standardized datasets, cross-device interoperability, and clinical validation in many areas.

In summary, while the technology is evolving rapidly, the next five years will focus heavily on making BCI systems faster to train, more reliable, and truly applicable in real-life settings—and that's where the real breakthroughs will happen.

4. For students entering the this field, what would you say are skills (technical and others) that are must-haves and that you and other companies look for when hiring?

Students entering the brain-computer interface (BCI) and neurotechnology field need to be well-prepared across multiple disciplines, as this is truly an interdisciplinary domain. At g.tec medical engineering, we're not just looking for academic excellence—we're looking for people who can translate knowledge into real-world applications that help patients, researchers, or industry users. Here are the must-have technical and non-technical skills we look for:

Technical Skills:

1. **Signal Processing and Machine Learning:** A deep understanding of EEG/ECoG signal processing, including filtering, artifact removal, time-frequency analysis, and statistical modeling, is essential. Knowledge of machine learning (especially real-time classifiers and adaptive algorithms) is becoming increasingly critical.

2. **Programming Proficiency:** We expect fluency in Python, MATLAB, or C++, and the ability to work with our own platforms like g.HIsys and g.Pype. Real-time data acquisition, visualization, and interaction are vital parts of BCI work.
3. **Neuroscience Fundamentals:** A solid grasp of neurophysiology and brain anatomy is critical. Candidates should understand the basics of cortical rhythms, event-related potentials (ERPs), and brain mapping.
4. **Hardware Familiarity**: Experience with biosignal amplifiers, EEG caps, electrode technologies, TMS, FES, or VR integration is a big plus. We value hands-on lab experience just as much as code.
5. **Data Management & Visualization**: Knowing how to structure, clean, and visualize high-volume biosignal data is crucial. We appreciate candidates who can explain data clearly to diverse audiences.

💡 ***Soft Skills and Traits:***
1. **Curiosity & Creativity**: We value people who ask "why" and "what if." The best ideas often come from unusual questions and interdisciplinary curiosity.
2. **Adaptability**: This field evolves rapidly—tools, paradigms, and even clinical standards change. We need individuals who can learn fast and pivot quickly.
3. **Team Collaboration**: Our work involves neuroscientists, engineers, clinicians, artists, and entrepreneurs. Communication and the ability to translate between domains are vital.
4. **Project Ownership**: We love hiring individuals who can take full responsibility for a project—from concept to prototype to deployment. Autonomy and initiative matter.
5. **Global Mindset**: Since g.tec is active in more than 140 countries, multilingual and multicultural awareness helps immensely, especially when working with clinical or academic partners abroad.

Finally, we encourage students to attend events like the BCI & Neurotechnology Spring School, join hackathons like BR41N.IO, and publish early. Hands-on experience and a visible passion for the field always make a candidate stand out.

5. How do you see the role of academia in addressing these current challenges in this area? Do you think there is room for collaboration between academia and industry in solving these issues?

Academia plays a fundamental role in advancing brain-computer interface (BCI) and neurotechnology. Most of the key breakthroughs in the field—from signal decoding algorithms to invasive electrode development—have their roots in academic research. Universities are the incubators of innovation, where researchers can explore bold, high-risk ideas that may not be feasible in a purely commercial setting. However, many of the most pressing challenges today—such as scaling BCI systems for clinical use, standardizing neurotech protocols, or ensuring regulatory compliance—require a strong bridge between academia and industry. This is where collaboration becomes essential.

At g.tec, we've always embraced that connection. We work with top academic institutions around the world and these partnerships help us translate scientific insights into usable tools for clinicians, engineers, and patients. For example, our recoveriX system was developed in collaboration with academic neurorehabilitation centers and is now being used globally to treat patients with stroke, Parkinson's, and MS.

There’s enormous room for synergy:

- Academia can focus on fundamental science, long-term innovation, and education.
- Industry brings engineering scalability, real-world deployment, and regulatory pathways.

Together, we can accelerate translational neurotechnology—moving from lab prototypes to global impact. To that end, we actively support students and researchers through hackathons, Spring School lectures, and open-access tools like our g.Pype Python SDK and datasets for replicable science.

In short: solving the hardest problems in neurotech—ethical AI integration, reliable non-invasive BCIs, and widespread clinical adoption—will only be possible through ongoing and deep collaboration between academia and industry.

6. Any last words of advice?

Choose one thing that truly excites you and go full speed. In a field as broad and complex as neurotechnology, it's easy to get distracted or overwhelmed by the sheer number of possibilities. But real breakthroughs come when you focus with intensity and consistency.

Whether you’re developing hardware, decoding brain signals, or creating clinical protocols—deep expertise and persistence will always outperform scattered curiosity. Once you've found your passion, commit fully, seek out collaborators, and don’t be afraid to fail fast and learn fast.

In the world of BCI, we are still writing the rules. So there’s no better time than now to jump in—and shape the future with purpose and velocity.