Industry Corner

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In this "Industry Corner" column, we interview Dr. Marc-Antoine Moinnereau from Kaptics. Dr. Moinnereau is a researcher–entrepreneur working at the intersection of physiological computing and immersive technologies. Trained as a biomedical engineer with a background in physiological signal processing, he completed his Ph.D. at the Institut National de la Recherche Scientifique (INRS) in Montreal in 2023, where his work focused on integrating biosensors such as EEG, EOG, and PPG into virtual reality systems to study human responses in immersive environments. This research led to the creation of Kaptics in 2022, a research spin-off he co-founded and now leads as CEO. The company develops custom hardware and software solutions that integrate physiological sensing into XR devices, making physiological data collection in immersive environments more accessible and easier to deploy in experimental protocols. Today, Kaptics collaborates with universities, research institutes, and industry partners internationally to support multimodal physiological measurement in immersive research, with applications in human performance, training, and emerging health domains.

1. Could you tell us about your professional journey and how your interests in neurophysiological signal processing and XR developed over time?

I first trained as an engineer at ESEO in France and later pursued a research master's degree at the University of Sherbrooke in Canada, where I was introduced to neuroscience and electroencephalography (EEG) analysis. In 2015, I tried virtual reality for the first time at the Laval Virtual conference. What immediately struck me was the ability to create controlled environments to study human behavior. I quickly saw the opportunity to combine immersive environments with physiological signals to better understand user experience through objective data, whether by monitoring human factors or exploring new forms of interaction using brain activity. This idea became the starting point of my PhD research. Because existing wearable EEG systems were difficult to use with VR devices, we had to design custom solutions to improve comfort and signal quality. From the beginning, my goal was to develop a technology that could be used beyond academic research. My work now focuses on translating these research ideas into robust tools and systems that support experimentation and applied research in XR.

2. From your perspective, how have intelligent systems—ranging from automation to AI-driven decision making—evolved during your time in industry?

One of the most important evolutions in intelligent systems has been the ability to analyze complex multimodal data in real time and use it to adapt systems to the user. In the past, most analyses were performed offline and mainly served for post-experiment interpretation. Today, advances in AI, computing power, and embedded systems allow us to process physiological, behavioral, and interaction data as it is generated. In immersive environments, this makes it possible to adapt the content of an experience based on the user's state, for example adjusting training difficulty or rehabilitation exercises when signals indicate cognitive overload or fatigue. Another important shift is that these capabilities are increasingly moving from controlled laboratory setups to deployable systems. With embedded AI and more compact sensing technologies, these systems can now be used in real training, research, or clinical environments to support more informed decisions.

3. Your work touches multiple areas, from algorithms and modeling to real-world deployment. How do you approach integrating ideas across different fields?

In practice, I usually start from the problem rather than from the technologies themselves. Many of the projects we work on originate from concrete needs expressed by research laboratories that want to measure human responses in immersive environments. Addressing these questions requires combining ideas from signal processing, neuroscience, wearable sensing, XR systems, and software engineering. Because existing tools are often difficult to use together in these contexts, we develop custom hardware and software that fit the experimental constraints and the type of data researchers want to collect. The goal is to make physiological data easier to capture and analyze. By integrating these different components into a single system, we can provide researchers with turnkey solutions that help accelerate experimental work.

4. What do you see as the unique strengths and challenges of doing research within an industrial R&D environment? What broad trends do you think will define the next decade of progress in BCI/XR?

My experience in industrial R&D has shown that one of its main strengths is the ability to move ideas from research into real-world applications much faster. Working closely with users and partners means that research questions are often driven by practical needs, which helps focus development on solutions that can actually be deployed. At the same time, this environment also brings challenges. Industrial research requires balancing scientific exploration with engineering constraints, product reliability, and timelines that are often shorter than in purely academic settings. Looking ahead, I believe the next decade of progress in BCI and XR will be driven by the maturation of sensing technologies, real-time signal processing, and embedded AI. As systems become more compact and easier to deploy, we will likely see a shift from laboratory experiments toward practical applications in areas such as training, rehabilitation, and human performance, where physiological signals can help create more adaptive and personalized environments.

5. As AI becomes more embedded in society, how should researchers think about responsibility, trust, and reliability in the systems they design?

Researchers need to approach AI systems with a strong emphasis on reliability and transparency. In many fields these systems rely on complex data and models that can easily be misunderstood or overinterpreted. Ensuring the quality of the data, clearly communicating the limits of the models, and validating results carefully are therefore essential to building trust. Researchers also have a responsibility to design systems that remain understandable and usable for the people who rely on them. As AI becomes more embedded in real-world applications, the focus should not only be on improving performance, but also on ensuring that systems behave consistently, are properly validated, and are used in ways that respect the people whose data they rely on.

6. For students and early-career professionals interested in intelligent systems, what foundational skills or mindsets do you consider essential?

Strong fundamentals remain essential. Areas such as mathematics, programming, signal processing, and data analysis provide the tools needed to understand how intelligent systems actually work. At the same time, the rapid progress of AI tools means it has become easier than ever to use powerful models without fully understanding their behavior. Developing a critical mindset is therefore increasingly important. Being able to question results, understand the limitations of models, and interpret outputs carefully is just as valuable as knowing how to use the tools themselves. Finally, a practical mindset also matters: experimenting, building systems, and working with real data are often the best ways to understand how these technologies behave in practice.

7. Beyond technical expertise, what non-technical skills have been most helpful to you in advancing your work?

Resilience. Developing new technologies rarely follows a straight path. Experiments fail, prototypes need to be redesigned, and ideas often take longer than expected to become usable systems. Being able to stay focused through this process and keep improving things step by step is essential when turning research concepts into technologies that can actually be deployed.

8. What advice would you give to young researchers who hope to bridge strong academic foundations with impactful real-world applications?

Try entrepreneurship ;) it’s a very effective way to see how research ideas behave outside the laboratory. More seriously, I think it helps to stay close to real problems and the people who face them. Strong academic foundations are essential, but understanding real-world constraints often changes how research is approached and what ultimately makes a technology useful.