POLARIS INSIGHT

MEET IRENA ZIVKOVIC

Hardware that touches the human body

Irena Zivkovic and the invisible art of MRI coil design

In the quiet heart of the Electrical Engineering department at TU Eindhoven, a revolution is taking shape. Irena Zivkovic, assistant professor and head of the MRI Hardware Development Lab, is redesigning the way MRI scanners "listen" to the human body. Her newest coil—based on an idea from a 1957 paper—isn't just technically elegant, it might also remove the need for expensive shielding and bring diagnostic imaging within reach for millions.

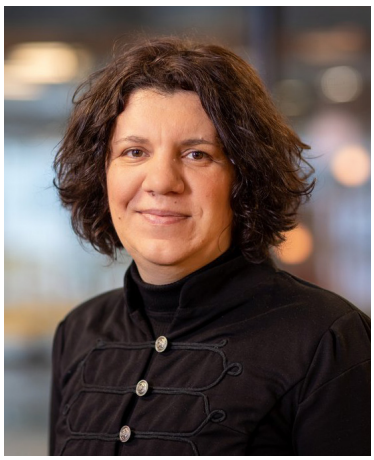


Foto from Tue by Angeline Swinkels

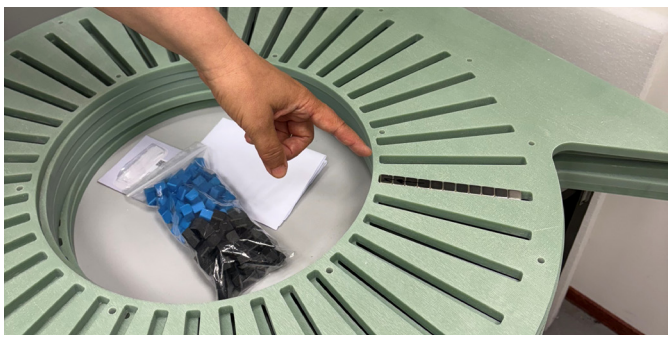
Rethinking the Coil: Fighting Noise with Silence

Most of us think of MRI scanners as giant, immovable machines in hospital basements. But Irena's team is building something else entirely: a portable, low-field MRI system with a completely new kind of coil. The challenge? At low magnetic field strengths, the signal-to-noise ratio (SNR) drops drastically; by up to a factor of 1300 compared to clinical 3T systems.

The coil Irena developed was inspired by a physics concept called the *anapole*, a non-radiating antenna structure. "*It's a solenoid curved into a toroid,*" she explains. *"It doesn't radiate, it holds the field inside. That means it doesn't pick up interference from the outside world. You just get the signal from the body, not from the environment."*

This self-shielding coil could eliminate the need for heavy Faraday cages around scanners. That opens the door to MRI systems in ICU wards, patient rooms, or even developing countries where access to MRI systems is limited. "More than 70% of the world's population has no access to MRI," Irena notes. "Even in the Netherlands or Germany, access is limited. We want to change that."

In this context, Irena and her team have recently completed a scientific article on the design of a "Toroidal RF Volume Coil" specifically tailored for low-field, portable Halbach-based MRI systems. The article details the theory, design process, and first results of this innovative coil architecture.



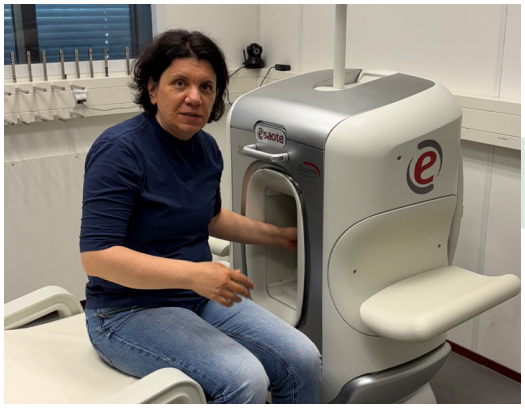
Full article is here available

Nationaal Groeifonds

Hands-on Science: A Researcher in the Lab

Her days start early—sometimes before 8:00—so she can squeeze in quiet lab time before meetings begin. Whether testing new coil geometries or revisiting old ideas with fresh simulations, she's a strong believer in physically building what you think. "That's how you get new ideas," she says. "*The theory helps, but the inspiration comes when you test and build.*"

Her two PhD students in Polaris, whom she knew from earlier internships, share that same drive. "*I want students who are self-motivated, who love what they're doing. You shouldn't suffer through a PhD; you should enjoy it, even if it's hard.*"



Irena's work is deeply practical. "*For me, it's all about the smell of soldering,*" she laughs. *"You need to feel the hardware in your hands to really understand how to improve it.*"

From Satellites to Scanners: A Personal Journey

Irena didn't begin her career in medicine. Her PhD in Switzerland focused on antennas for meteorological satellites, and she worked at Caltech and the University of Illinois on astronomy-related applications. But she felt the need to work on something more directly useful to people.

"*I was always fascinated by electromagnetics," she says. "When I saw the 9.4T MRI in Tübingen, it was the highest frequency used in medicine at that time. It made sense for me to apply my knowledge there.*"

From Max Planck in Germany to LUMC in Leiden and now Eindhoven, Irena has shaped her own path. "*People trusted me to do what I imagined. That gave me freedom to develop better coils, metamaterials, and antennas. And now, at TU/e, we're building our own scanner. That will really speed things up*."

Polaris Potential: Crossing Boundaries

Polaris, for Irena, is more than just a funding program. It's a platform for translating innovations across domains. "*We're working with Philips on integrating our self-decoupled coils into their digital receiver chains. These coils don't interfere with each other, which means we can position them optimally and improve performance.*"

That concept self-decoupling isn't just useful in MRI. "*It's relevant for radar, for communications, for any antenna arrays*," she says. "*You can rescale the design to operate at different frequencies while keeping the same properties. It's elegant, and not easy to do.*"

She also sees potential in anapole antennas for secure RFID and contactless systems, where you want to enable near-field communication without unwanted far-field radiation perfect for privacy-sensitive applications.

Vision and Drive

What would Irena do with unlimited resources? *"We'd finish our portable scanner," she says immediately. "And I'd build stronger daily collaborations with clinicians."* She sees immense value in combining deep engineering knowledge with a first-hand understanding of medical needs.

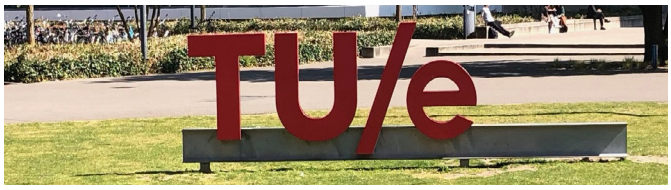
"*We engineers sometimes say 'this is for Alzheimer's,' but we don't really know what that means clinically. When I attend medical conferences on dementia or neurodegeneration, I understand better what doctors are really looking for. Then I can think about what to build that truly helps.*"

She dreams of developing cheap, portable MRI systems that can detect brain atrophy, a precursor to dementia, before symptoms begin. "*It would be a game-changer in early diagnosis,*" she says.

Off the Clock: Sport, Nature, and Friendly Rivalries

Outside of research, Irena is a passionate sports fan. "I used to run competitively, 400 and 800 meters," she says. "*Now I play tennis with colleagues. I won a few times, so maybe I'll retire undefeated,*" she jokes.

She also loves hiking and skiing, "*real mountains, not indoor,*" she clarifies. But above all, she finds energy in staying active, curious, and engaged. "*When you love what you do, it doesn't feel like punishment,*" she says. "*That's what I try to give my students too. Enthusiasm is something we can't buy. Everything else, we can.*"



Contact Information

For questions or suggestions regarding the POLARIS Insight, feel free to email us at info@polaris-ngf.nl

For the latest news? Follow us on LinkedIn @polaris-ngf and our website www.polaris-ngf.nl