

Popular science summary of the PhD thesis

PhD student	Kamil Wojciech Mikolaj
Title of the PhD thesis	From Automated 2D Analysis to 3D Reconstruction: Advancing Ultrasound Imaging with AI-Driven Methods
PhD school/Department	Department of Applied Mathematics and Computer Science

Science summary

Ultrasound is widely used because it is safe, quick, and portable, yet results still depend on how the probe is handled and which frames are saved. This work develops artificial intelligence that makes routine examinations more consistent without changing clinical workflows. Using large collections of real hospital scans, the methods identify standard views in two-dimensional fetal ultrasound, judge whether the anatomy is clearly visible, and derive measurements directly from the images, including estimates of fetal growth with uncertainty. In prospective tests that mirrored day-to-day practice, the automated selections were often rated at least as good as manual choices and supported more reliable screening for cardiac defects and growth concerns.

Three dimensional ultrasound is gaining traction because it is more reproducible and less dependent on the operator than traditional two dimensional scans. A 3D volume captures the whole structure at once, which makes results more consistent and allows some imperfections to be reduced when many views are combined. Building on this, one line of work focuses on fast 3D reconstruction from probe sweeps while keeping the image cues clinicians rely on for interpretation. A complementary line of work estimates the patient's breathing from the data and corrects for it during reconstruction, so the 3D picture stays steady and aligns better with other scans such as CT or MRI.

In sum, the thesis advances ultrasound along two complementary tracks. The first delivers improvements that can be applied today in routine 2D practice. The second develops 3D reconstruction and motion handling that lay the groundwork for the next generation of ultrasound.



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Please submit the summary to the department PhD coordinator together with your thesis