



UPPSALA
UNIVERSITET

Thesis Projects

at **Computer-assisted Applications in Medicine Group**

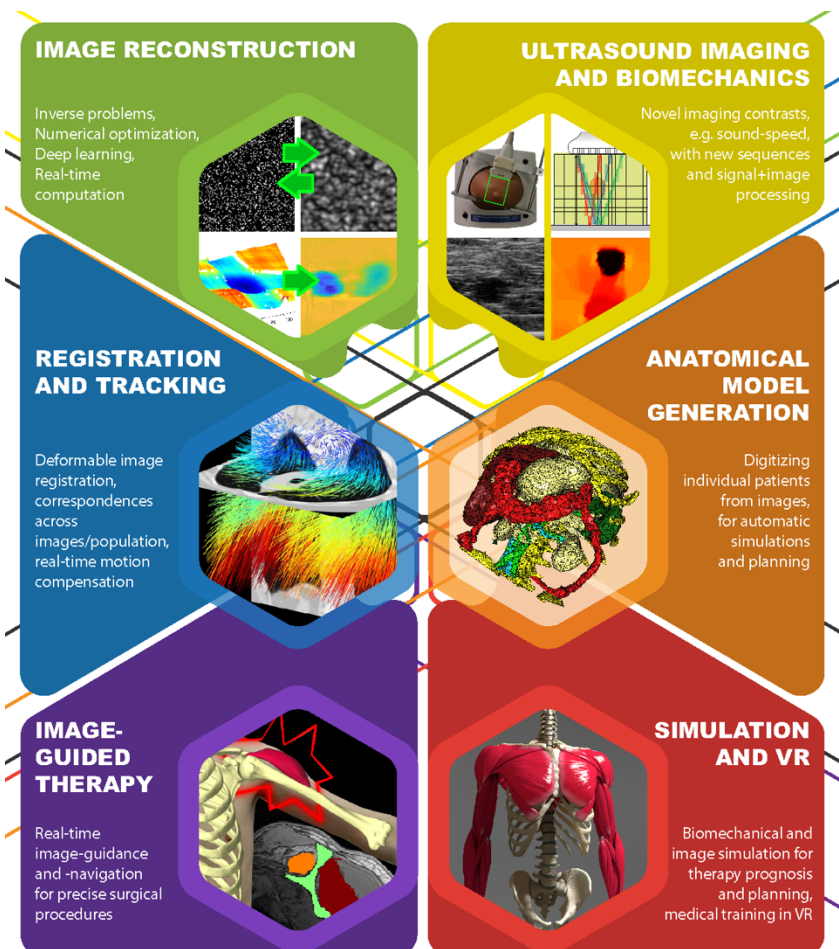
*Uppsala University, Department of Information Technology (it.uu.se)
& Medtech Innovation and Science Centre (medtech.uu.se)*

Computer-assisted Applications in Medicine (CAiM) Group, led by Orcun Göksel, is part of the newly-established [Medtech Innovation and Science Centre](#) as well as of the [Centre for Image Analysis](#). CAiM is within the administrative [Division of Visual Information and Interaction](#) at the [Department of Information Technology](#) of [Uppsala University](#) in Sweden.

Basic and applied research in CAiM involve data analysis and information extraction, on topics lying at the intersection of multiple disciplines: computer science, engineering, and medicine. With the involvement of diverse and cross-disciplinary skill-set, the group aims to devise novel imaging and image analysis techniques, and develop them for clinical translation. The group's efforts push the boundaries of diagnostic and surgical procedures as well as minimally-invasive interventions.

Research in CAiM is conducted in close collaboration with clinical as well as industrial partners, where the research results have a strong translational component, both clinically and commercially. To that end, CAiM aims to develop innovative diagnostic and interventional applications, focusing on data analysis from imaging to abstracting patient-specific models and representations, and from there to optimal intervention planning and intra-operative execution.

Student projects can be chosen in discussion with the group leader from a range of exciting topics, based also on the interests and background of the student. For an incomplete list of potential project topics and directions (together with some sample publications to gain more insight into the topics), please refer below to the second page.



Group Leader: Orcun Göksel, Associate Professor

For contact info: <https://katalog.uu.se/profile/?id=N19-1793>

Novel imaging techniques based on ultrasound

This line of work involves **quantitative imaging** and **image reconstruction** in diagnostic and interventional clinical applications, and relates to *tissue biomechanical characterization, inverse problems in imaging, and signal processing*. Novel imaging techniques, especially based on ultrasound physics, is a major interest.

Sanabria, Ozkan, Rominger, **Goksel**: "[Spatial Domain Reconstruction for Imaging Speed-of-Sound with Pulse-Echo Ultrasound: Simulation and In-Vivo Study](#)", *Physics in Medicine and Biology* 63:215015, Oct 2018.

Ruby, Sanabria, Martini, Dedes, Vorbürger, Oezkan, Frauenfelder, **Goksel**, Rominger: "[Breast Cancer Assessment With Pulse-Echo Speed of Sound Ultrasound From Intrinsic Tissue Reflections: Proof-of-Concept](#)", *Investigative Radiology* 54(7):419-427, Jul 2019.

Rau, Schweizer, Vishnevskiy, **Goksel**: "[Speed-of-Sound Imaging using Diverging Waves](#)", 1-12, Oct 2019.

Rau, Unal, Schweizer, Vishnevskiy, **Goksel**: "[Frequency-Dependent Attenuation Reconstruction with an Acoustic Reflector](#)", *Medical Image Analysis*:1-13, Oct 2020.

Deep Learning

Method development and applications for a range of subjects including image reconstruction, image translation, domain adaptation, few-shot and unsupervised learning.

Bernhardt, Vishnevskiy, Rau, **Goksel**: "[Training Variational Networks with Multi-Domain Simulations: Speed-of-Sound Image Reconstruction](#)", *IEEE Trans Ultrasonics, Ferroelectrics, and Frequency Control* 67(12):2584-2594, Dec 2020.

Vishnevskiy, Rau, **Goksel**: "[Deep Variational Networks with Exponential Weighting for Learning Computed Tomography](#)", In MICCAI, pp. 310-318, Shenzhen, China, Oct 2019.

Zhang, Vishnevskiy, **Goksel**: "[Deep Network for Scatterer Distribution Estimation for Ultrasound Image Simulation](#)", *IEEE Trans Ultrasonics, Ferroelectrics, and Frequency Control* 67(12):2553-2564, Dec 2020.

Pati, Foncubierta-Rodríguez, **Goksel**, Gabrani: "[Reducing Annotation Effort in Digital Pathology: A Co-Representation Learning Framework for Classification Tasks](#)", *Medical Image Analysis*, 2020.

Modeling and Simulation

Long-standing interests of the group in these areas cover anatomical modeling, e.g. for biomechanical and functional simulation, as well as model-based image simulation such as for medical training simulators (analogous to flight simulators).

Péan, **Goksel**: "[Surface-based Modeling of Muscles: Functional Simulation of the Shoulder](#)", *Medical Engineering and Physics* 82:1-12, 2020.

Joos, Péan, **Goksel**: "[Reinforcement Learning of Musculoskeletal Control from Functional Simulations](#)", In MICCAI, pp. 135-145, Oct 2020.

Mattausch, Makhinya, **Goksel**: "[Realistic Ultrasound Simulation of Complex Surface Models Using Interactive Monte-Carlo Path Tracing](#)", *Computer Graphics Forum* 37(1):202-213, Feb 2018.

Zhang, Portenier, Paulus, **Goksel**: "[Deep Image Translation for Enhancing Simulated Ultrasound Images](#)", In MICCAI Workshop on Advances in Simplifying Medical Ultrasound, pp. 85-94, Oct 2020.

Medical Image Registration, Real-time Tracking and Navigation

have been an ongoing interest, mainly for intervention guidance and navigation, such as in radiation therapy and image-guided surgery.

Vishnevskiy, Gass, Szekely, Tanner, **Goksel**: "[Isotropic Total Variation Regularization of Displacements in Parametric Image Registration](#)", *IEEE Trans Medical Imaging* 36(2):385-395, Feb 2017.

Gass, Szekely, **Goksel**: "[Consistency-Based Rectification of Non-Rigid Registrations](#)", *SPIE J Medical Imaging* 2(1):014005, May 2015.

Gass, Szekely, **Goksel**: "[Registration Fusion using Markov Random Fields](#)", In Workshop on Biomedical Image Registration (WBIR), pp. 213-222, London, UK, Jul 2014.

Crimi, Makhinya, Baumann, Thalhammer, Szekely, **Goksel**: "[Automatic Measurement of Venous Pressure Using B-Mode Ultrasound](#)", *IEEE Trans Biomedical Engineering* 63(2):288-299, 2016.

Gomariz, Li, Ozkan, Tanner, **Goksel**: "[Siamese Networks with Location Prior for Landmark Tracking in Liver Ultrasound Sequences](#)", In IEEE Int Symp on Biomedical Imaging (ISBI), 1757-1760, Venice, Italy, 2019.