Title:
From Pixels to Possibilities: Generative AI for Application-Tailored Synthetic Imaging

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Company name / Institute: **Eindhoven University of Technology**
Project name: **TASTI: Application-tailored synthetic image generation**
Funding group: **XECS**

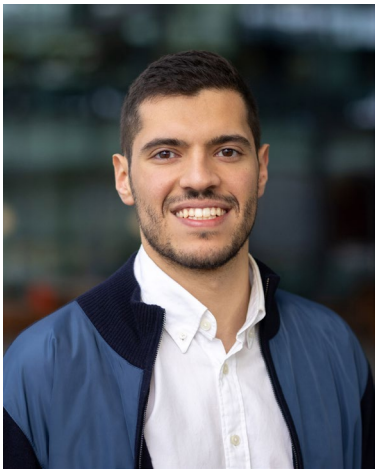
Generative image models have advanced rapidly, evolving from specialized generative adversarial networks to diffusion and increasingly general-purpose foundation models capable of synthesizing and editing highly realistic visual content. Beyond creating convincing images, these models offer new opportunities for imaging applications where real-world data are scarce, expensive, sensitive, or difficult to acquire.

In this presentation, we provide a technical overview of modern generative image modelling and discuss how these technologies can be adapted to domain-specific imaging problems. We draw on experiences from the Xecs TASTI project, which investigated application-tailored synthetic image generation across healthcare, automotive, manufacturing, and agriculture. Rather than relying on a single generative approach, TASTI explored a “generative zoo” of complementary models and techniques, illustrating how different application constraints require different combinations of generative modelling, domain knowledge, conditioning, and simulation.

Through examples from TASTI and our subsequent research, we illustrate how synthetic images can support data augmentation, simulation, domain adaptation, and the development of computer vision systems. We will also discuss some of the remaining challenges, including controllability, physical and semantic fidelity, validation of synthetic data, and the gap between visually plausible images and images that are genuinely useful for downstream algorithms.
The presentation concludes with a perspective on the transition from task-specific generative models toward flexible generative foundation models, and how these developments may change the way synthetic imaging pipelines are designed for future industrial and scientific applications.



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