



*"In autonomous driving it is common to use fisheye cameras in order to maximise the field of view. This results in images that appear "spherical". In order to classify such images it is desirable to use deep learning architectures in which the rotational symmetries of the image can be integrated into the neural network."*

## AI @Chalmers Project spotlight

# Exploring the underlying symmetries of AI

*The step from fundamental research to applications, especially in mathematical sciences, can often be quite long, but when we connect math to AI the divide becomes smaller, says Professor Daniel Persson, who leads two WASP-funded research projects at Chalmers.*

When you train a machine to recognize objects, you put in images of the object until the machine has learned to recognize it. The AI technology of today is really good in detecting and recognizing objects. However, if the image is rotated or curved it is much more difficult for the AI to detect it. For a machine to better understand things like traffic scenes, molecular structures, climate data or medical images it needs to be trained to understand the underlying symmetries of the data.

"In all these fields mathematics can be applied. That is why math and AI is so exciting. You have a basic theory that you may apply in many different situations", says Professor Daniel Persson at Chalmers Department of Mathematical Sciences.

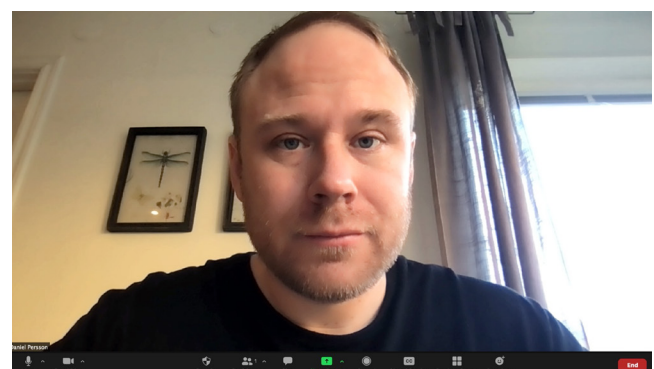
He is the supervisor of two PhD students in the WASP-funded projects Quantum Deep Learning and Renormalization and Group Equivariant Convolutional Neural Networks. In the projects they use group theory to construct neural networks that are adapted to the desired symmetries. In 2020 they obtained their first theoretical results by developing a mathematical framework that achieves this. They also started to obtain their first experimental results for spherical images.

"This could for instance be very useful for self-driving cars and medical image analysis, just to name a few applications", says Daniel Persson.

In their work they collaborate with researchers at Zenseact,

that are developing software for autonomous driving at Lindholmen in Gothenburg. But Daniel Persson also sees other potential applications, ranging from health care to cosmology.

"The step from fundamental research to applications, especially in mathematical sciences, can often be quite long, but what is happening when we start working with AI is that the divide becomes smaller. We can put fundamental research straight into AI applications to improve the neural networks. And in turn we can use AI as an aid to explore fundamental research", he says.



*Daniel Persson, Mathematical Sciences.*