

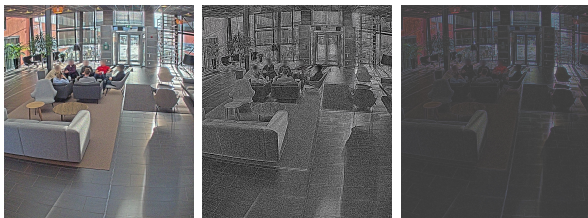
**MASTER THESIS** Self-Optimization of Camera Hardware**STUDENTS** Simon Kristofferson Lind, Johannes Tykesson**SUPERVISORS** Luigi Nardi (LTH), Waqar Hameed (Axis Communications)**EXAMINER** Volker Krueger (LTH)

# Automagically tuning camera quality

POPULAR SCIENCE SUMMARY **Simon Kristofferson Lind, Johannes Tykesson**

When new cameras are developed, their image quality has to be tuned by expert engineers, which normally takes several weeks. Our thesis shows that tuning can be done automatically in a matter of minutes.

Most cameras today come with a large number of settings that can change the image quality in many ways. Examples of such parameters are *contrast* and *saturation*. Our thesis was done at Axis Communications, and our work focused on parameters in the camera's ISP chip. These ISP chips usually contain hundreds of individual parameters that all have different effects on the image quality. Some effects are shown below:



Traditionally, all these parameters are manually tuned by expert imaging engineers who often spend several weeks to tune a single camera. Therefore, our thesis aims to automate this tuning process.

First, we needed to be able to tell if an image from the camera is good or bad. In order to do that, we compared it to a *reference* image. In practice, this reference image comes from a camera that has already been tuned.

Next, we implemented several optimization al-

gorithms. These algorithms were then hooked directly to a camera, which allowed parameters to be tuned automatically.

Since hundreds of parameters is a massive task for most optimization algorithms, we started out small by experimenting with 14 parameters. Seeing that 14 parameters worked very well, we expanded to include the most important components in the ISP chip. In total, we tuned a staggering 71 parameters.

After running our tests, we were pleased to find that our tuned images were nearly identical to the reference image:



Can you tell which one is the reference image? Neither can we.

In conclusion, our results show that it is possible to automatically tune 71 parameters in under 15 minutes.

Tuning all these parameters automatically should save a lot of time for the human engineers.