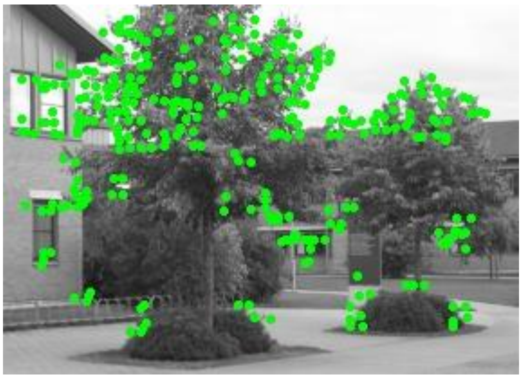
# MACHINE VISION.

Lab04: Interest Points

**BACKGROUND.**



In Lecture 4 we looked at interest point detection using the structure tensor. In this exercise you will implement the Shi-Tomasi interest point detection algorithm. On Canvas you will find the input image **house.png** to use with this exercise.

**Task 1.**

Load and display the input image. Convert the input image into grayscale for further processing.

**Task 2.**

Calculate and display the two gradient images using convolutions with a derivative of Gaussian kernels.

$$g_{x;\sigma_d} = I \otimes -\frac{x}{2\pi\sigma_d^4} \exp - \frac{x^2+y^2}{2\sigma_d^2}$$

$$g_{y;\sigma_d} = I \otimes -\frac{y}{2\pi\sigma_d^4} \exp - \frac{x^2+y^2}{2\sigma_d^2}$$

Use a derivative smoothing factor of $\sigma_d = 1$. Make sure you work with float images to avoid discretisation issues.

**Task 3.**

Calculate for each pixel $p$ in the image the weighted structure tensor

$$S_{\sigma_w;\sigma_d}[p] = \sum_i w_{\sigma_w}[|p-p_i|] \begin{pmatrix} g_{x;\sigma_d}^2[p_i] & g_{x;\sigma_d}[p_i] g_{y;\sigma_d}[p_i] \\ g_{x;\sigma_d}[p_i] g_{y;\sigma_d}[p_i] & g_{y;\sigma_d}^2[p_i] \end{pmatrix}$$

where this is feasible. Use the Gaussian weighting function

$$w_{\sigma_w}[r] = \frac{1}{\sigma_w\sqrt{2\pi}} e^{-\frac{r^2}{2\sigma_w^2}}$$

with the scale factor $\sigma_w = 2$.

**Task 4.**

Calculate the eigenvalues for each structure tensor calculated in task 3. Create an image matrix containing the minimum eigenvalue to use as interest metric for each pixel. Display the matrix as image. Try different scales $\sigma_d$ and $\sigma_w$ and observe what happens.

**Task 5.**

Threshold the matrix calculated in task 4 and suppress all non-maxima. Extract a list of interest point coordinates and draw them into the input image. Select a suitable threshold and display the result.