

## Lab 1: Motion estimation and tracking

**If you do not use thresholding, what could mistakenly be identified as motion?**

- Without thresholding, minor and insignificant changes in pixel intensities, which could be due to noise, camera sensor irregularities, or subtle lighting variations, might be misinterpreted as motion. This can lead to false positives where the algorithm detects motion where there is none or exaggerates the magnitude of actual motion.

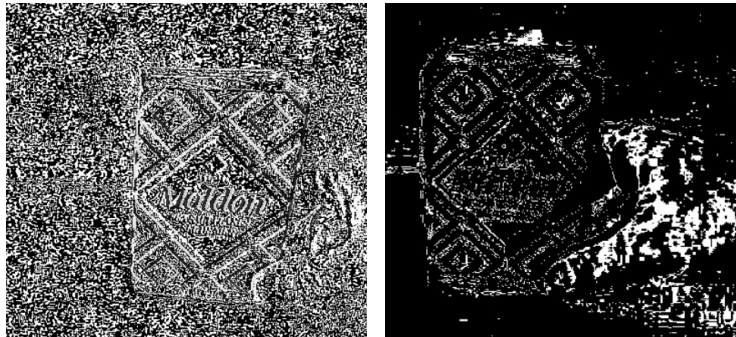


FIGURE 1. *Threshold of 0 (left) and threshold of 250 (right).*

**Can this optic flow account for any type of motion? If not, give two distinct cases when it will not work well.**

- **Large Motion:** When objects in the scene move significantly between frames, the assumption of small motion is violated.
- **Non-Uniform Illumination Changes:** Sudden or significant changes in lighting between frames can disrupt the brightness constancy assumption, leading to erroneous flow vectors.

**How many motion parameters can be reliably extracted? How does the block size affect the results?**

- The number of motion parameters that can be reliably extracted typically depends on the complexity of the motion and the scene. 4 DoF can be reliably extracted in scenarios where the motion between the camera and the object is relatively simple and the object remains parallel to the camera plane, minimizing perspective distortions. 6 DoF parameters can be reliably extracted in scenarios that involve more complex interactions with the environment and the object's orientation relative to the camera significantly changes.
- The results of smaller blocks are enhanced detail at the cost of greater susceptibility to noise and computational demand, and larger blocks have improved noise handling and efficiency but reduced spatial precision.

**When does the tracker perform well/poorly on live video? What image processing might improve performance? What are the advantages/disadvantages of using other warps?**

- The tracker tends to perform well on live video with consistent lighting and when motion between frames is small and smooth. It performs poorly in cases of fast or complex motion, drastic changes in lighting, and occlusions.
- Smoothing or denoising can improve performance by reducing noise and making motion more consistent.

- Using affine warps can model more complex motions and perspectives but at the cost of increased computational complexity and potential overfitting to noise or minor variations.



FIGURE 2. *Poor tracker performance on variational lighting during camera movement (arrow points to reflected light variation).*

### How will tracking window size affect the results of a higher-dimensional tracker?

- The size of the tracking window significantly impacts the results of a higher-dimensional tracker. Larger windows can capture more extensive motion patterns and are more stable against noise but might average out important local variations. Smaller windows are sensitive to local motion details but can be more affected by noise and may fail to capture larger motion patterns.