After brightness constancy assumption calculation:

Second Assumption/Constraint

You'll note that the brightness constancy assumption gives us one equation with two unknowns (u and v), and so we also have to have another constraint; another equation or assumption that we can use to solve this problem.

Recall that in addition to assuming brightness constancy, we also assume that neighboring pixels have similar motion. Mathematically this means that pixels in a local patch have very similar motion vectors. For example, think of a moving person, if you choose to track a collection of points on that person's face, all of those points should be moving at roughly the same speed. Your nose can't be moving the opposite way of your chin.

This means that I shouldn't get big changes in the flow vectors (u, v), and optical flow uses this idea of motion smoothness to estimate u and v for any point.

Where is Optical Flow Used?

Optical Flow is a well-researched and fast algorithm and it is used in a lot of tracking technology, today! One such example is the NVIDIA Redtail drone, which uses optical flow to track surrounding objects in a video stream.

Next: Localization

This introductory lesson was meant to give you a starting idea of how motion is represented and how one can go about estimating the motion of an object. Most of this section will be about tracking and localizing moving objects!

Next, you'll see how to tackle a complex problem: localization. Localization is all about finding out exactly where an object is in an environment and then tracking it over time as it moves (and in the case of a robot) as it gathers sensor measurements via camera, radar, LiDAR, or other sensors.

Localization is a key concept in the field of autonomous vehicles, so let's dive in!