CYCLE 4

Optical Flow and Block Matching Algorithm

Dataset: All experiments use the KITTI Stereo 2015 / Flow 2015 / Scene Flow 2015 dataset, using grayscale images from the image_2 folder of any sequence.

Q1: Compute dense optical flow between the frames using the Farneback algorithm and visualize the motion vectors as arrows over the first frame. **Comment on differences in motion vectors in fast-moving vs slow-moving regions.**

Q2: Select two consecutive frames from a sequence. Divide the frames into 16×16 pixel blocks. For each block in the first frame, find the best matching block in the next frame using SAD (Sum of Absolute Differences). Compute and display motion vectors as arrows over the first frame. **Comment on: a) Which regions exhibit larger motion vectors and why? b) How stationary regions appear in terms of motion vectors? c) How the choice of block size affects the accuracy of motion estimation?**

Q3: Select two consecutive frames from a sequence. Using motion vectors (obtained from block matching), predict the next frame from the first frame. Compute the residual difference image between the predicted frame and the actual next frame. Visualize the original frame, predicted frame, and residual image side by side. **Comment on: a) How accurately does the predicted frame match the actual frame? b) Which regions have larger residual errors and why? c) How motion vectors contribute to reducing frame-to-frame redundancy?**

Depth Perception and Disparity Matching

Dataset: All experiments use the KITTI Stereo 2015 / Flow 2015 / Scene Flow 2015 dataset, using left and right grayscale images from the image_2 and image_3 folders of any sequence.

Q4: Select a stereo image pair (left and right images) from a KITTI sequence. Compute the disparity map using StereoSGBM. Convert the disparity map to a depth map using the camera focal length and baseline. Normalize and visualize both the disparity map and the depth map. **Comment on: a) How disparity values relate to object distance? b) Which regions appear closer or farther in the depth map?**

Q5: Using a stereo image pair, compute the disparity map and convert it to a depth map. Detect and highlight objects that are closer than a specified depth threshold. Visualize the result by overlaying detected obstacles on the original image or depth map. **Comment on a) Which objects are detected as obstacles and why? b) How changing the depth threshold affects detection results?**