ECSE-415 Introduction to Computer Vision

Assignment #5: Motion Estimation

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i. *Assumption: image measurements in a small region remain the same although their location may change.*

Brightness constancy: $I(x,y,t) = I(x+u,y+v,t+1)$

(x,y) is the pixel coordinate in the frame, t is the time. (u,v) is the displacement

$I(x+u,y+v,t+1) - I(x,y,t) = I_x u + I_y v + I_t$

$I(x,y,t) = I(x+u,y+v,t+1)$

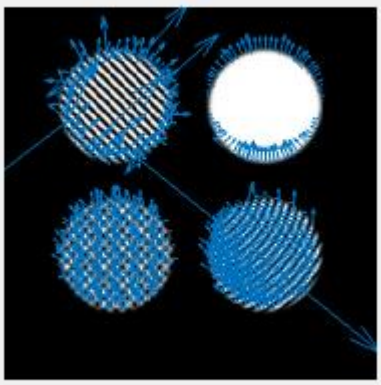
Therefore, optical flow equation is $I_x u + I_y v + I_t = 0$, where I_x , I_y is the image derivative along x and y, I_t is the difference over frames.

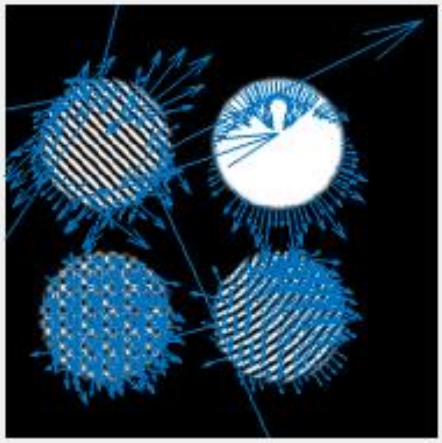
We cannot use this equation alone to recover image motion at each pixel. For each pixel we have one equation with two unknowns. We need another constraint for a pixel.

ii. *In question i. we know that we need another constraint to build second equation to solve optical flow equation. We assume: neighboring points in the scene typically belong to the same surface and hence typically have similar motions, since they also project to nearby points in the image, we expect spatial coherence in image flow.*

$I_x(p_i)u + I_y(p_i)v + I_t(p_i) = 0$

iii. *Lucas-Kanade optical flow two results*

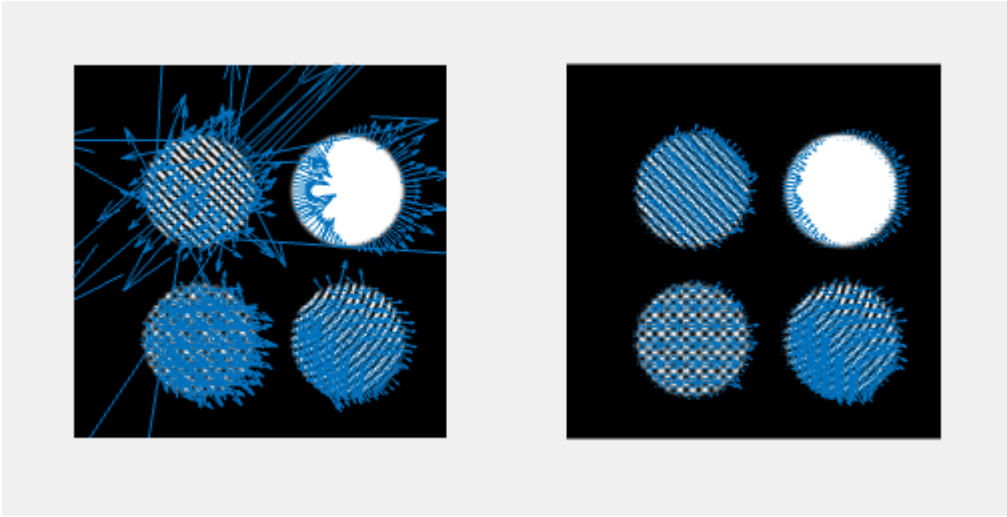




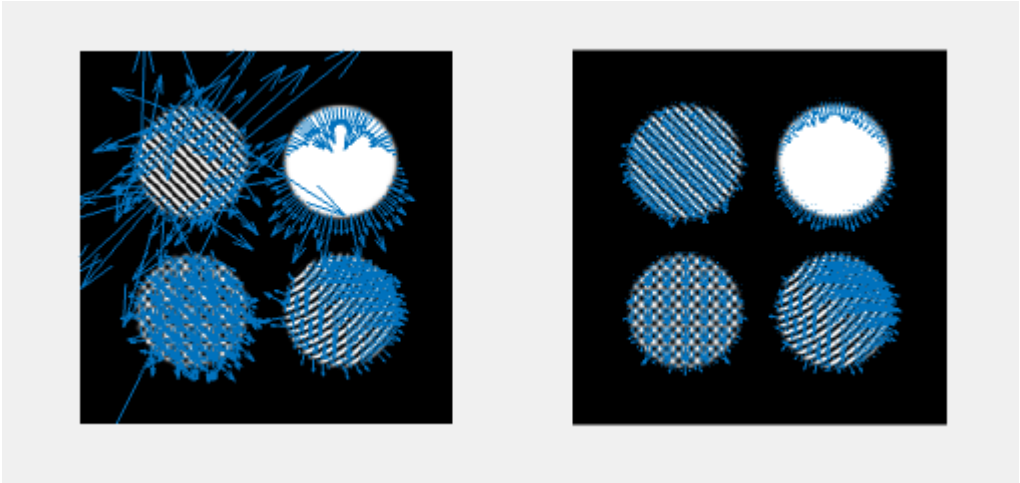
Based on the results, following type of pattern is estimated correctly

iv. *Lucas-Kanade(left side) and Horn-Schunck(right side) comparison*

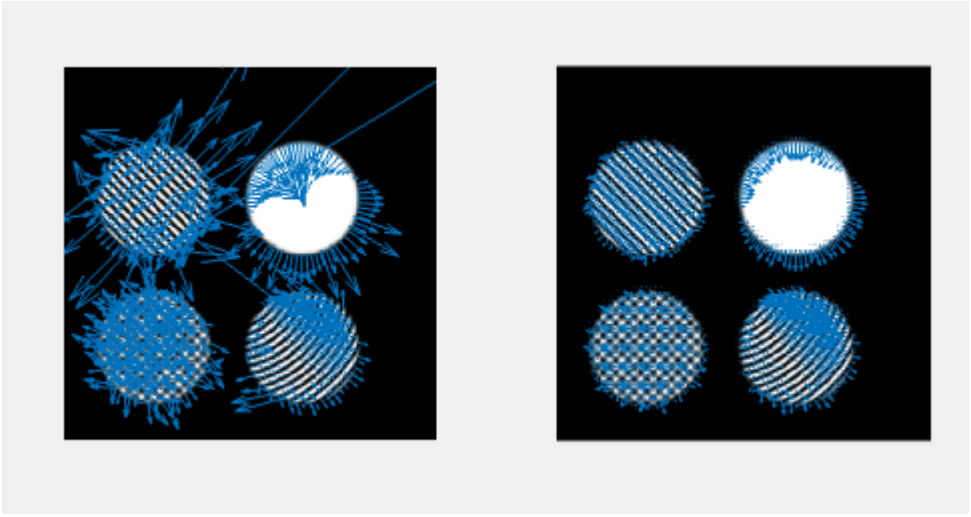
Pure horizontal



Pure vertical



Combined motion



Based on the results, Horn-Schunck approaches have a better result.