MOTION DESCRIPTORS

Robert B. Fisher
School of Informatics
University of Edinburgh

©2014, School of Informatics, University of Edinburgh

INSTANTANEOUS ACTION PRIMITIVES

Stabilise moving object

Compute optical flow

Compute descriptors based on the optical flow

©2014, School of Informatics, University of Edinburgh

IMAGE STABILIZATION?

Temporal difference: subtract consecutive frames

Threshold temporal difference for regions of interest

Use maximum cross-correlation $cc(dc, dr)$ of consecutive frames inside region of interest to estimate frame-to-frame translation (dc, dr):

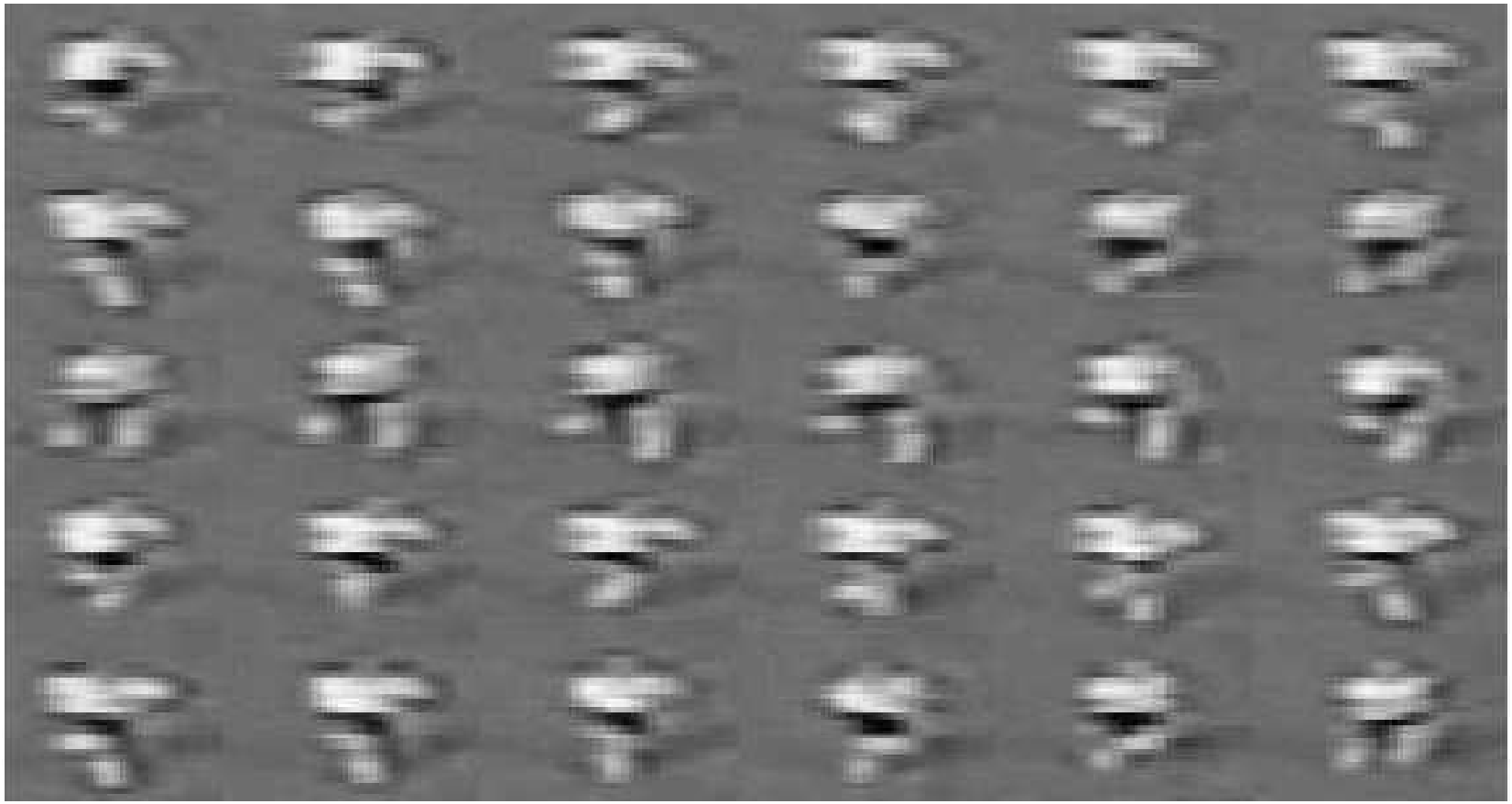
©2014, School of Informatics, University of Edinburgh

$$cc(dc, dr) = \frac{\Sigma_{(c,r)\in ROI(t)}(I^t_{c,r} - \mu^t)(I^{t+1}_{c+dc,r+dr} - \mu^{t+1})}{\sigma^t \sigma^{t+1}}$$

Where:
$pROI(t+1)$ is $ROI(t)$ shifted by (dc, dr) into image $t+1$:
$\mu^t = mean(ROI(t))$
$\mu^{t+1} = mean(pROI(t+1))$
$\sigma^t = \sqrt{\Sigma_{(c,r)\in ROI(t)}(I^t_{c,r} - \mu^t)^2}$
$\sigma^{t+1} = \sqrt{\Sigma_{(c,r)\in pROI(t+1)}(I^{t+1}_{c,r} - \mu^{t+1})^2}$

©2014, School of Informatics, University of Edinburgh

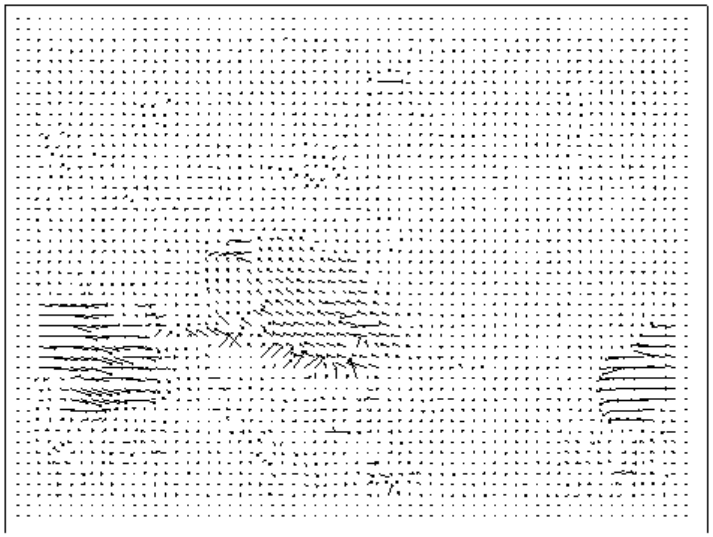
STABILISED RUNNER



©2014, School of Informatics, University of Edinburgh

OPTICAL FLOW

Image velocity (u, v) at every pixel: where each pixel's data is moving to in next image

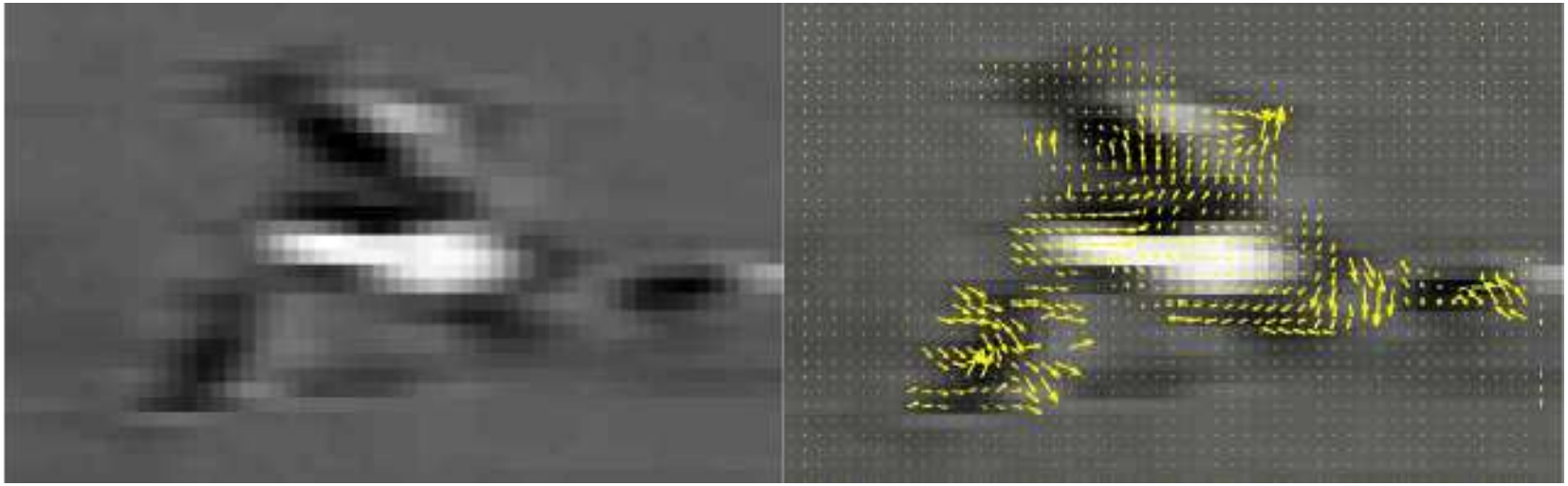


Computed by standard algorithms that match local gradients to temporal gradients

©2014, School of Informatics, University of Edinburgh

OPTICAL FLOW DESCRIPTORS 1

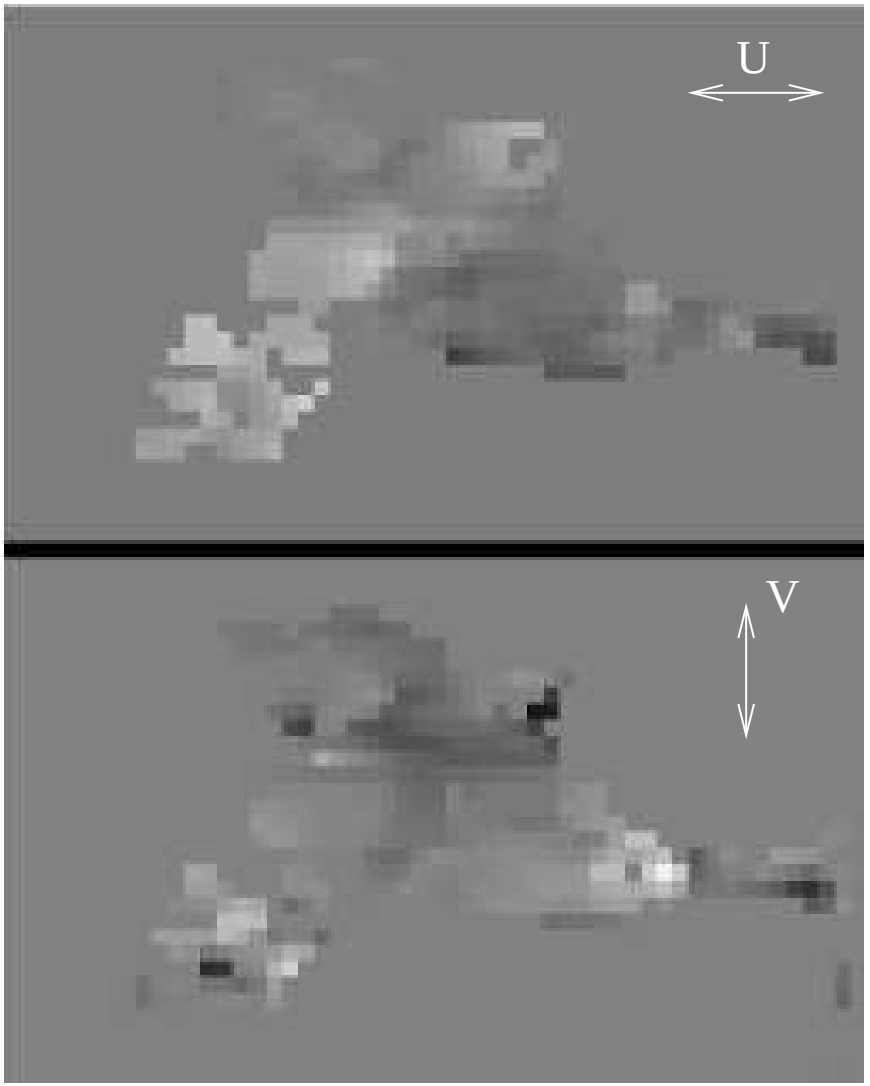
Optical flow image = $[...(u_{c,r}, v_{c,r})...]$



Goal: create a descriptor based on this noisy relative OF

©2014, School of Informatics, University of Edinburgh

OPTICAL FLOW DESCRIPTORS 2



u, v components

©2014, School of Informatics, University of Edinburgh

OPTICAL FLOW DESCRIPTORS 3

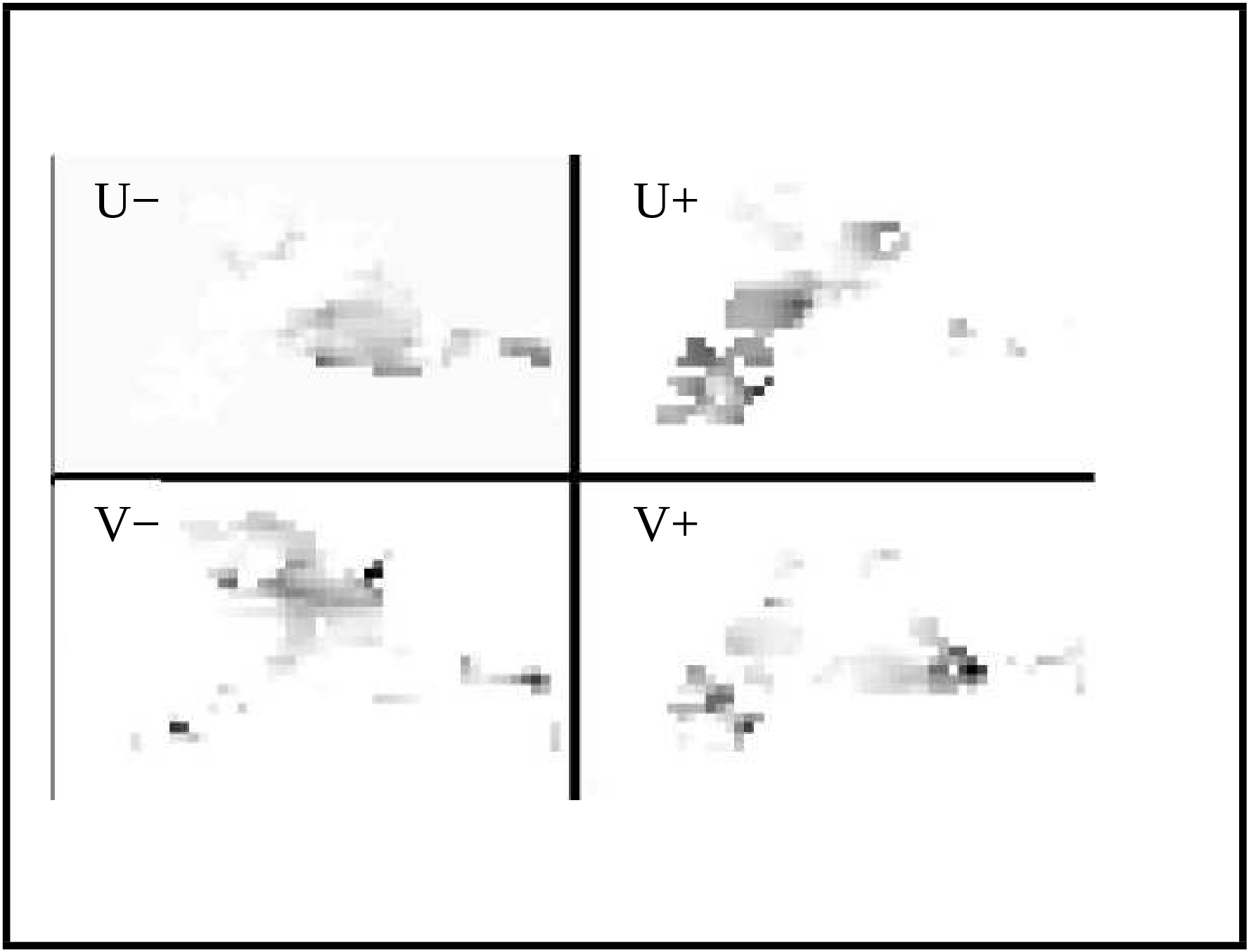
Noisy so smooth, but smoothing cancels +/- aspects

Solution: split +/- components

$f(x) = x$ if $x \geq 0$ else $x = 0$

$(u_i, v_i) \rightarrow (f(u_i), f(-u_i), f(v_i), f(-v_i))$

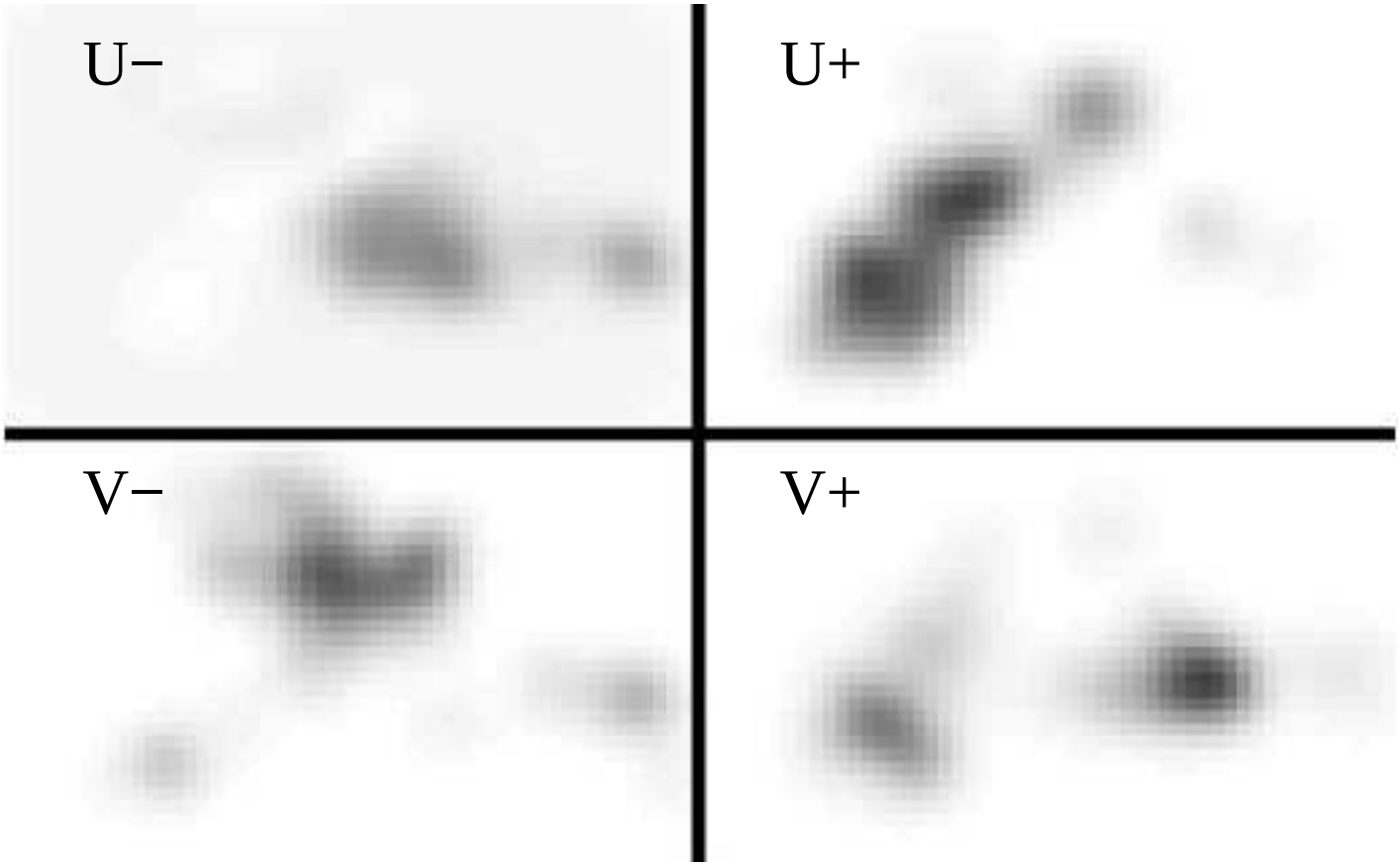
©2014, School of Informatics, University of Edinburgh



©2014, School of Informatics, University of Edinburgh

OPTICAL FLOW DESCRIPTORS 4

Convolve with Gaussian to smooth



Descriptor: sequence (50 frames) of smoothed O.F. windows

©2014, School of Informatics, University of Edinburgh

Resulting Descriptor

Gives: $a_c^i(x, y)$ for every frame i of seq. a

c = 1,2,3,4 optical flow components

(x, y) = pixel positions

Summary: rich, subtle (varies across object), but view dependent

©2014, School of Informatics, University of Edinburgh