**Good Features to Track**

**Abstract**

Selecting features that can be tracked well and correspond to physical points in the world is still hard.We propose a feature selection criterion that is optimal by construction and which can also detect occlusions,disocclusions and features that do not correspond to points in the world.

**Introduction**

Dissimilarity is used as a measure to take out the good features from a frame.

Dissimilarity is the feature’s rms residue between the first and the current frame and when the dissimilarity grows too large feature should be abandoned.Two models of image motion are considered here,linear warping and translation because pure translation is not adequate.

**Two Models of Image Motion**

A later image taken at time t + τ can be obtained by moving every point in the current image taken at time t by a suitable amount. The amount of motion ∂=( ξ, η) is called the displacement of the point at **x**=(x,y)

The displacement vector ∂ is a function of image position x and variation in ∂ are often noticeable even within the small windows used for tracking and affine motion field is a better representation.

∂=Dx+d

D=dxx dxy

dyx dyy

is a deformation matrix and d is the translation of feature windows centre.

The image coordinates x are measured with respect to the windows center. Then a point x in the first image I moves to point Ax+d in the second image J, where A=I+D and is the I is the 2x2 identity matrix.

J(Ax+d)=I(x)

Given two images I and J and a window in image I and J and a window in image I, tracking means determining the six parameters that appear in the deformation matrix D and displacement vector d. The quality of this estimate depends on the size of the feature window, the texturedness of the image within it and the amount of camera motion between frames.

For small window, matrix D is harder to estimate

However smaller windows are preferable because they are less likely to straddle discontinuity. So a pure translational model is preferable where D is assumed to be zero.

∂=d

**Computing Image motion**

Because of image noise and affine motion model is not perfect J(Ax+d)=I(x)

this above equation is not satisfied exactly. Determining the motion parameters is a problem of finding A and d, that minimize the dissimilarity

€=∫∫W[J(Ax+d)-I(x)]2w(x)dx

where W is the given feature window and w(x) is the weighting function. To minimize the residual in above equation we differentiate it w.r.t unknown entries of D and displacement vector d and set result to zero. We the linearize the resulting system by truncated taylor expansion

J(Ax+d)=J(x)+gT(u)

This yields the following linear 6x6 system

Tz=a

where zT=[dxx dyx dxy dyy dx dy ]

collects the entries of D and d, the error vector

T=∫∫W[u v vT z]wdx

During tracking motion between adjacent fames must be small initially for tracking to work. Attempting to determine deformation parameters in this situation can lead to poor displacement solutions and errors in d. When the goal is to determine d the smaller system

Zd=e where e collects the last two entries of vector a.

Features between first and current frame, it is acceptable for d and D to interact to some extent through V.

**Texturedness**

If the two eigen values of Z are λ1 and λ2, we accept a window if min(λ1, λ2)> λ where λ is predefined threshold.

It doesnot matter if one component of deformation cannot be determined reliably. This means that, that component doesnot effect the window and any value along this component will do in comparision.Whenever some component is undetermined the minimum norm solution is computed that is solution with zero deformation along the undetermined component.

**Dissimilarity**

In figure1 the size of the sign increases by about 15% and the dissimilarity measure increases rather quickly with the frame number,as shown by dashed and crossed line of figure3.The bottom row of figure2 shows the same windows as in top row but warped by computed deformations. The deformations make the five windows virtually equal to each other. In figure4 the feature tracked is the bright window on the background on the right of traffic sign. The bright window from figure4 is occluded by the traffic sign in middle frame. The bottom row shows effects of warping by computed deformation matrices. The circled curves in figure3 are dissimilarity measures under affine motion and pure translation. The sharp jump in affine motion curve around frame4 indicates occlusion

**Convergence**

The tracking algorithm workscorrectly and as we see in figure6, I makes the images in the fourth column as similar as possible to those in fifth column for the algorithm to converge.

**Monitoring Features**

In Pure translational model, almost all features have the same dissimilarity. So we use affine model to distinguish good and bad features. The features in which dissimilarity is less are good features where as those with high dissimilarity are abandoned.