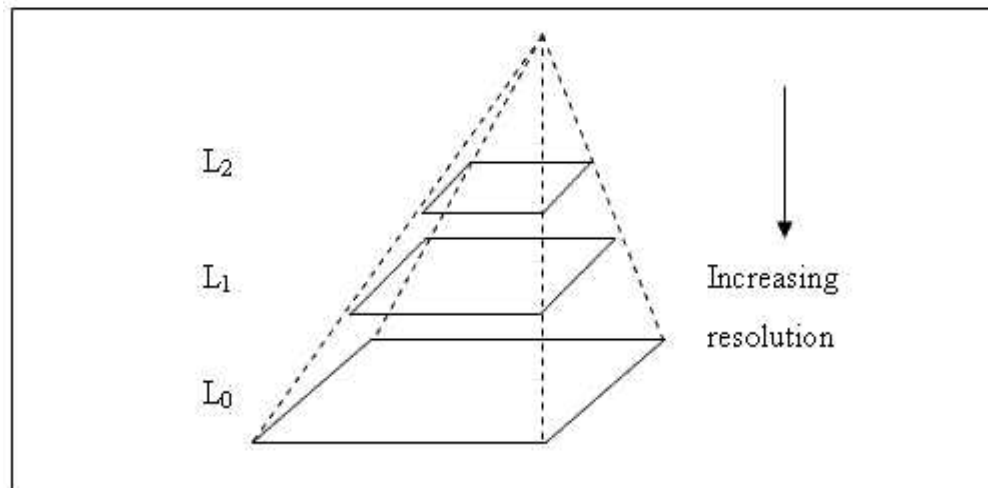# 18CSE390T
# Computer Vision

# Hierarchical Motion Estimation

# Hierarchical Motion Estimation

- To accelerate search process, hierarchical motion estimation is used.

- An image pyramid is constructed and a search over a smaller number of discrete pixels (corresponding to the same range of motion) is first performed at coarser levels

# Hierarchical Motion Estimation(Cont…)

•In order to create a lower resolution image from the initial one, two approaches can be used: The mean intensity or subsampling.

•In the case of grey-level images, for the mean intensity approach, each block of (usually) four pixels is replaced by one, having their mean intensity. That is:

$$g_L(p,q) = \left[ \frac{1}{4} \sum_{u=0}^{1} \sum_{v=0}^{1} g_{L-1}(2p+u, 2q+v) \right], 1 \leq L \leq 2 \quad (1)$$

# Hierarchical Motion Estimation(Cont…)



Block

Frame k

Search window

Frame k+1
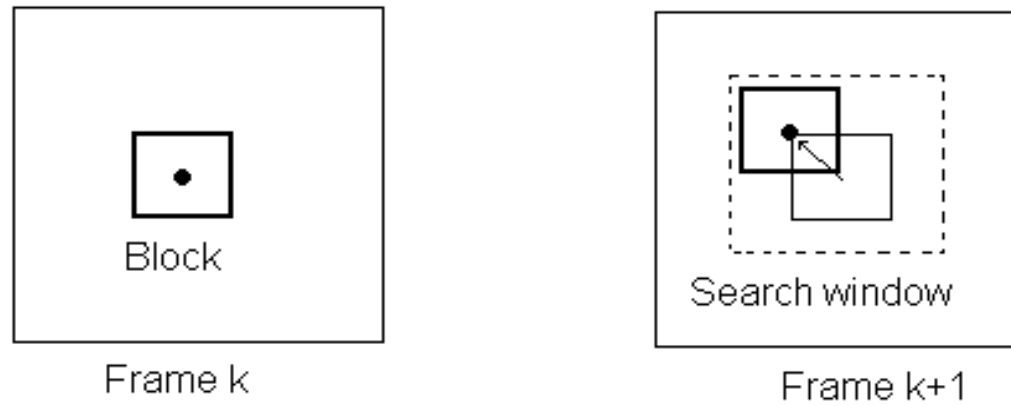
In order to compare blocks, a measure of the block difference has to be established. The most widely used block distance measure is the Mean Absolute Difference:

$$MAD(i,j) = \frac{1}{mn} \sum_{k} \sum_{l} \left| g_f(k,l) - g_{f-1}(k+i,l+j) \right| \quad (2)$$

# *Flowchart of the generic Hierarchical Motion Field Estimation algorithm*
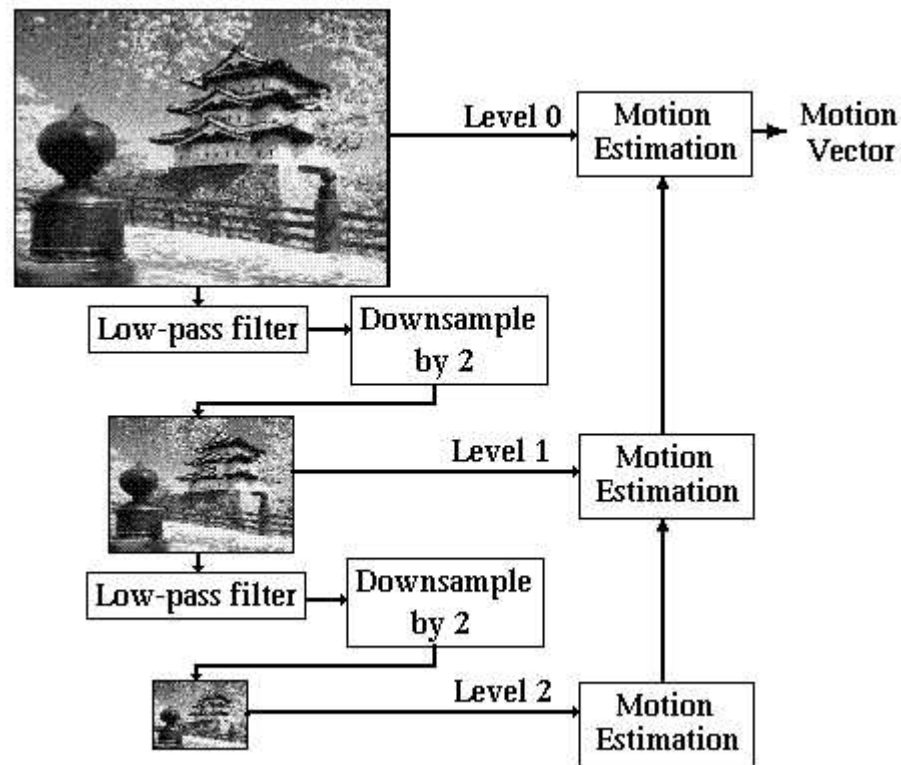
# Hierarchical Motion Estimation

- Steps
  - Construct image pyramid
  - At coarser levels, search over a smaller number of discrete pixels
  - Motion estimation at coarse level is used to initialize a smaller local search at the next finer level
- Not guaranteed to produce the same results as a full search, but works almost as well and much faster

# Hierarchical Motion Estimation

- Image downsampling $I_k^{(l)}(\mathbf{x}_j) \leftarrow I_k^{(l-1)}(2\mathbf{x}_j)$

- Coarsest level: search for the best $\mathbf{u}^{(l)}$ that minimize the difference between $I_0^{(l)}$ and $I_1^{(l)}$

  - Full search over the range $2^{-l}[-S, S]^2$

- Predict a likely displacement $\hat{\mathbf{u}}^{(l-1)} \leftarrow 2\mathbf{u}^{(l)}$

  - Search over displacement is repeated at the finer level over a much narrower range

  - Incremental refinement step with warped image