Episodic Structure

- Episodic structure can be studied by using graphs to represent an episodic network.
- Analysis of this structure can be used in future models of episodic memory and context reinstatement.

Basic concepts of graph theory and small-world structure

Small-world Structure

A small-world network possesses the following properties:

1. The small-world effect means most pairs of vertices are connected by a short path through the network.
2. High “clustering” or “transitivity” means that if two vertices have another neighboring vertex in common, there is a high probability that these two vertices will be connected directly to each other.

Clustering Coefficient

Global clustering coefficient defined as follows:

\[ C = \frac{3}{N(N-1)} \sum_{i=1}^{N-2} \frac{S_i}{m_i} \]

- A triangle means three vertices are pairwise connected to both of the others.
- Each triangle contributes to three separate connected triples.
- A connected triple means a vertex that is connected to an (unordered) pair of other vertices.

Image Graphs

Microsoft Research SenseCam
- Microsoft Research SenseCams are used to capture images for several subjects.
- Each subject carried a SenseCam to record the images for their daily lives.
- The SenseCam can take photographs at regular intervals (8 seconds).
- The sensors in the SenseCam will automatically take pictures when changes in color, light-intensity and temperature are detected.

Representation in HSV Space

- HSV color space used.
- The hue circle consists of the primaries red, green and blue separated by 120 degrees.
- Quantization of hue requires the most attention. Thus, H is quantized to 30 levels and S & V is quantized to 10 and 3 levels.
- The quantized HSV space has 900 histogram bins.

Color Histogram and Distance Measure

- Color histogram used.
- Use histogram intersection distance to measure the similarity among images.
- The intersection of histograms h and g is given by:

\[ d(h, g) = \sum_{a,b,c} \min(h(a,b,c), g(a,b,c)) \]

Graph-theoretic Analyses of Episodic Graphs

Scale-free properties

- The degree of a vertex in a network is the number of edges incident on or connected to that vertex.
- If there are n nodes in a network and d_i of them have degree k, then the degree distribution p(k) of a network is defined to be p(k) = n/k.
- A scale-free network is a network whose degree distribution follows a power law.

Global clustering coefficient

Global clustering coefficient for IMDB graphs (the right panel is the magnified plot for the coefficient plot of image graphs’ clustering curve of IMDB graphs at the early stage)