

A Lagrangian Particle Dynamics Approach for Crowd flow Segmentation [Saad Ali, Mubarak Shah]

As the name suggests the paper uses the concepts of “Lagrangian” particle dynamics. (In Lagrangian, individual particles are followed through time as against Eulerian where flow is described as function of position and time). That involves the calculation of:

- **Finite Time Lyapunov Exponent Field (LTFE):** An asymptotic quantity which measures extent to which infinitely close particles separate in infinite amount of time. Lyapunov exponents measure the exponential rate of convergence or divergence between two particles
- **Lagrangian Coherent Structures (LCS):** Locally maximizing curves of the field (FTLE) that appear as ridges. They are edges separating flow segments of different dynamics from each other.

The steps of the algorithm:

1. Flow field calculation: based on block based correlation in the fourier domain
2. Particle advection: Lagrangian trajectory is computed by solving differential equation. Mention the use of Runge-Kutta-Fehlberg algorithm and cubic interpolation
3. Flow maps and FTLE field: Maps for grid of particles of how x and y co-ordinate is changing with time is maintained. Gradient maps are also computed.
4. FTLE field segmentation: Shi-Malik normalized cut algorithm. The distance measure is Lyapunov divergence between pair of particles.
5. Flow instability: Shape of flow represented by a Gaussian probability distribution of spatial co-ordinates of pixels belonging to flow segment. Voting scheme is employed for establishing correspondence between flow segments of pair of blocks. A flow segments have similar dynamics if majority of pixels vote for flow and correspondence can be established.

Results shown on few sequences like Mecca, NYC marathon.

Data driven Crowd Analysis in Videos [Rodriguez et al]

- Data driven and offline
- Principle: although the space of distinguishable crowd motions patterns is infinite the space of distinguishable crowd motion patterns might not be that large
- Create a database of crowd motion patterns
- **Crowd motion pattern representation:**

- **Low level:** sparse or dense optical flows, spatio-temporal gradients, feature trajectories obtained using KLT tracking
- **Mid-Level: Correlated Topic model** of motion words obtained by encoding scene in to 36 x 24 cells of size of 20 x 20, with each pixel having a value from the set {0, up, down, left, right}
- **Matching:**
 - Global : Gist descriptor
 - Patch : HOG3D descriptor
- **Key Idea : Transfer learned Crowd behaviors:**
 - Use Kalman filter but with 'motion priors'
 - Priors are obtained by finding the most similar crowd from the database
- Experiments
 - Tracking typical crowd behaviors
 - Mean tracking error compared with ground truth trajectories for 100 individuals
 - Tracking rare and abrupt events
 - Individual motions which do not conform to global behavior patterns of the same video. Couple of examples shown.