Marked Point Processes for Crowd Counting
Weina Ge and Robert T. Collins
Computer Science and Engineering Department, The Pennsylvania State University, USA

A crowd scene as a realization of an MPP

\[ \pi(o|I) \propto \pi(I|o) \prod \pi(o_i) \]

\[ \pi(o_i) = \pi(p_i)\pi(w_i, h_i, \theta_i|p_i)\pi(s_i) \]

- **determine location, scale, orientation**
- **determine body shape**
- **Estimating extrinsic parameters**
  - Original image
  - Orientation axes of a sequence
  - Inliers found by RANSAC
  - Vertical vanishing point
- **Learning intrinsic shape classes**
  - EM iterations
  - Bayesian EM with Dirichlet prior
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- Bayesian approach
  - MPP prior
  - Combined with likelihood

Estimating configurations by MCMC
- birth: add person
- death: delete person
- update location: random walk
- update shape: change shape

- Delineate pedestrians in a foreground mask using shape coverings
  - rectangular covering
  - shape covering

- Adapt to different videos by learning the shape models
  - Training samples
  - Automatically learned shapes