

# Weekly Report

Survey & Propose Framework

# Paper Survey

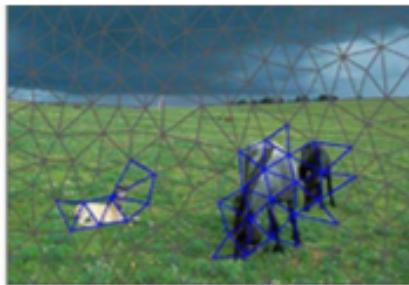
- Image Retargeting Using Mesh Parametrization
  - Yanwen Guo, Feng Liu, Jian Shi, Zhi-Hua Zhou, Senior Member, IEEE, and Michael Gleicher
  - Transactions on Multimedia 2009

# Framework

- Preserve the ratio of the subject
- Mesh-based image retargeting



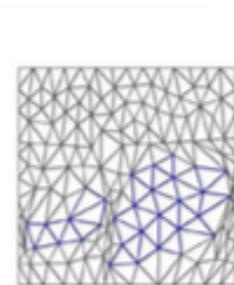
(a)



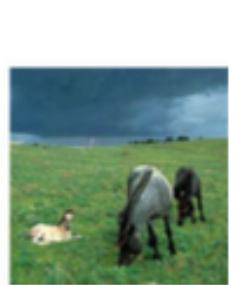
(b)



(c)



(d)



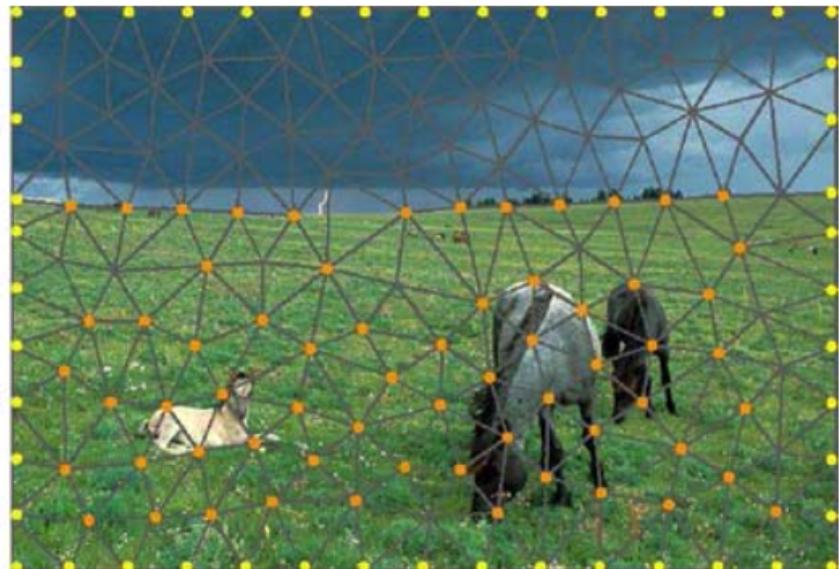
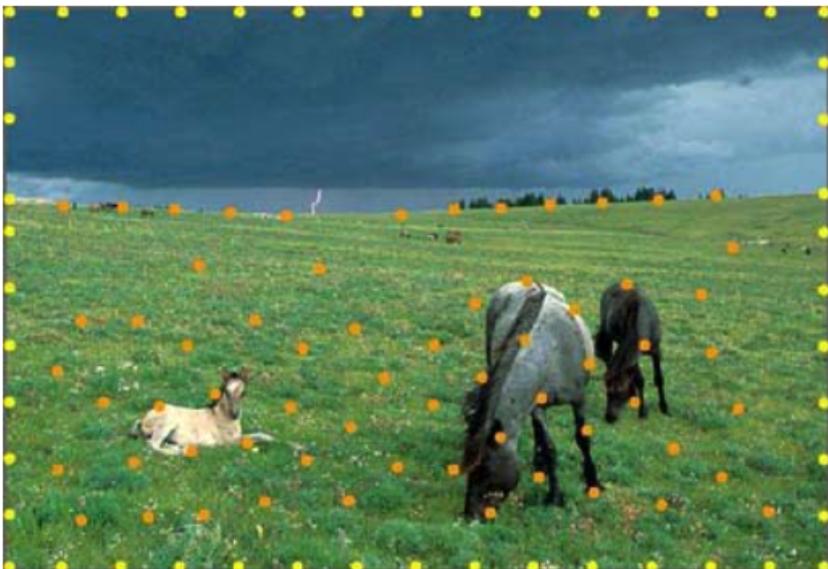
(e)

# Importance Computation

- Salience Detection
  - Contrast-based saliency detection method proposed by Ma et al. ACM MM 2003
- Human Face Detection
  - Viola-Jones face detector
  - Use a rough mask and graph-cut algorithm to extract the whole body

# Image Representation

- Image Boundary
- Edge Detection Operator
  - Canny operator
  - Only use Part of Canny: keep mesh points using a distance threshold
- Use Delaunay triangulation to generate mesh edge



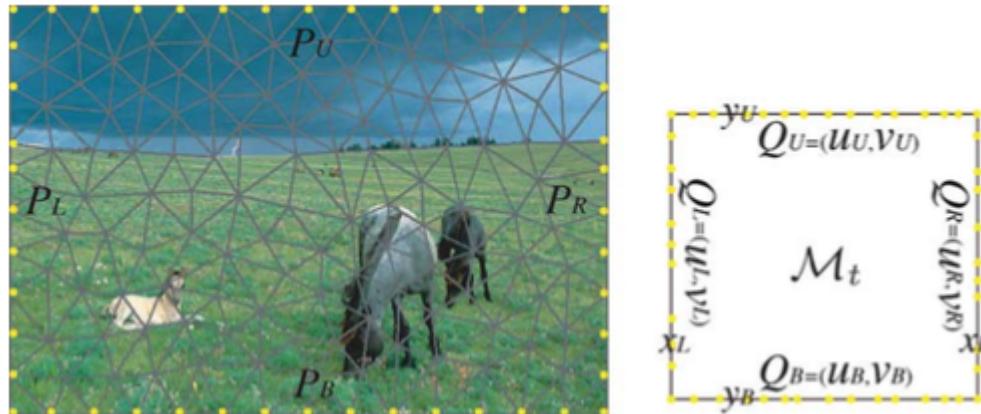
# Image Representation

- Notation
  - Source mesh  $\mathcal{M}_s$  and target mesh  $\mathcal{M}_t$
  - Points in source  $\{P_i = (x_i, y_i) | i = 1, \dots, n\}$   
in target  $\{Q_i = (u_i, v_i) | i = 1, \dots, n\}$
  -

# Constraint in Parametrization

- Boundary Constraint

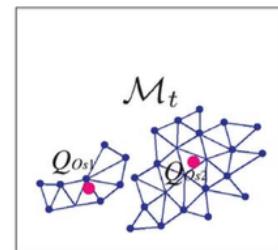
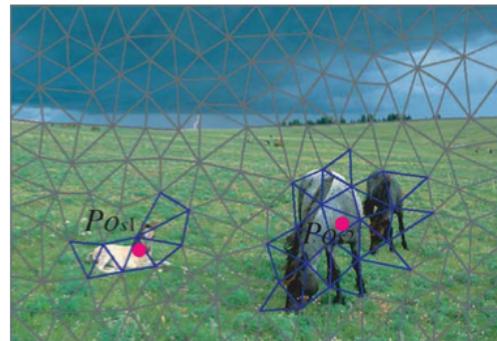
$$F_B = \sum_{i=1}^{n_U} |v_{U,i} - y_U| + \sum_{i=1}^{n_B} |v_{B,i} - y_B| \\ + \sum_{i=1}^{n_L} |u_{L,i} - x_L| + \sum_{i=1}^{n_R} |u_{R,i} - x_R| = 0.$$



# Constraint in Parametrization

- Saliency Constraint
  - $O$  is the set of salient object

$$\left\{ O_{sj} = \bigcup_{i=1}^{n_j} (S_{\Delta_i} > S_{\mu}) \mid j = 1, \dots, J \right\}$$



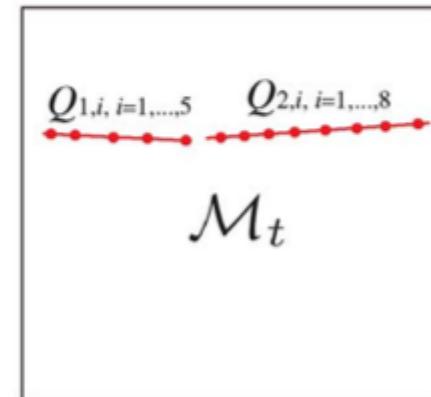
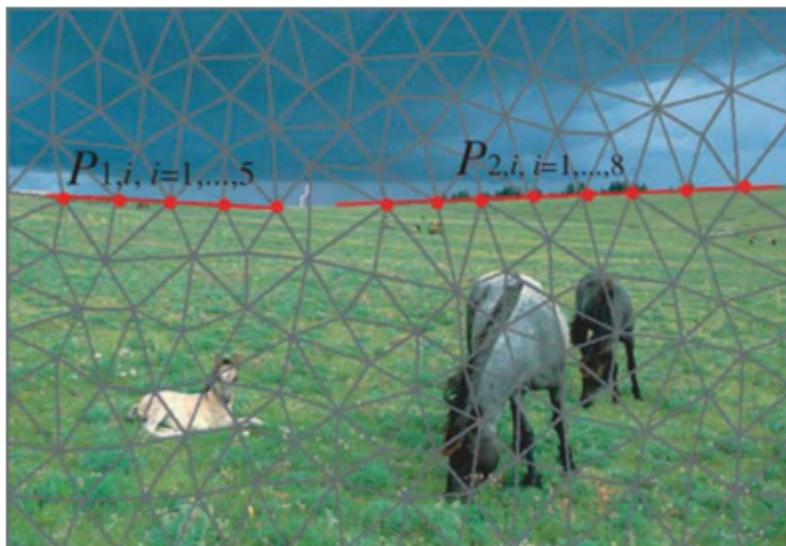
- Only scaling transformation is allowed for salient object
- Polar Coordinates:
  - Mass center:  $P_{O_{sj}}$
  - Coordinate of  $P_i$  in  $O_{sj}$ :  $(r_i, \theta_i)$
  - Scaling factor  $z_{O_{sj}}$
- Constraint

$$F_{SA} = \sum_{j=1}^J \left( \sum_{i=1}^{n_j} |Q_i - f(Q_{O_{sj}}, z_{O_{sj}} \cdot r_i, \theta_i)| \right) = 0$$

# Constraint in Parametrization

- Structure Constraint
  - Strong edge:
    - Hough Transform
  - Constraint

$$E_{ST} = \sum_{k=1}^K \left( \sum_{i=1}^{m_k} (v_{k,i} - a_k \cdot u_{k,i} + b_k)^2 \right)$$
$$y = a_k \cdot x + b_k$$
$$v_{k,i} = a_k \cdot u_{k,i} + b_k$$



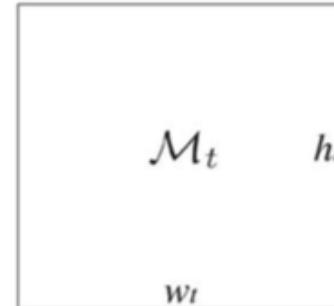
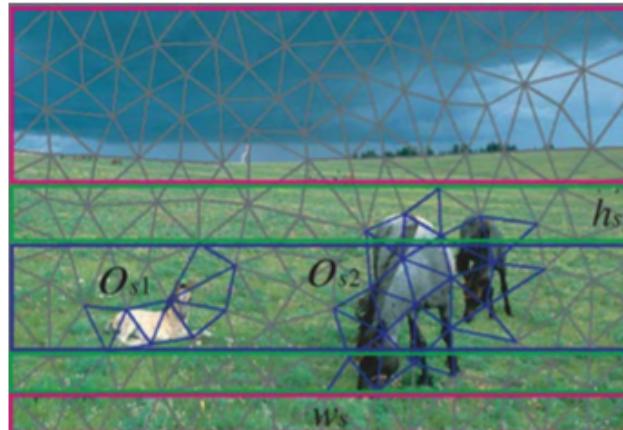
# Constrained Mesh Parametrization

- Computation of Edge Lengths of Target Mesh
  - Address scale in x and y direction separately
  - Scaling factor

■ red region:  $w_t/w_s$

■ other region:

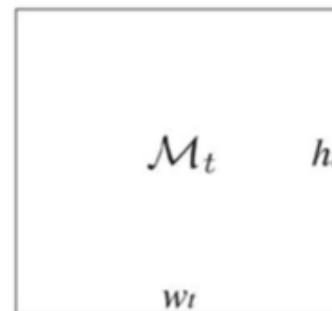
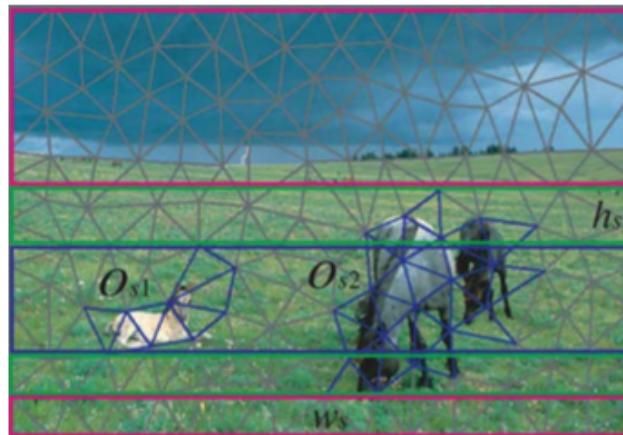
$$\frac{\left( w_t - \sum_{j=1}^J z_{O_{sj}} * l_{O_{sj}} \right)}{\left( w_s - \sum_{j=1}^J l_{O_{sj}} \right)}$$



# Constrained Mesh Parametrization

- Computation of Edge Lengths of Target Mesh
  - For edge  $e(P_iP_j)$  average of the scaling factor of  $P_i$  and  $P_j$ 
    - $(s_{xij}, s_{yij})$

$$l_{ij} = l_{e(Q_iQ_j)} = \sqrt{(s_{xij} * l_{xij})^2 + (s_{yij} * l_{yij})^2}.$$



# Constrained Mesh Parametrization

- Mesh Parametrization
  - Minimize energy

$$E_l = \sum_{(Q_i Q_j) \in edges} \frac{(\|Q_i - Q_j\|^2 - l_{ij}^2)^2}{l_{ij}^2}.$$

(Salient object are preclude)

$$\operatorname{argmin}_{Q_i, i=1, \dots, n} (E_l + \lambda \cdot E_{ST}), \text{ s.t. } F_B, F_{SA} = 0.$$

- Use texture mapping algorithm to fill the image.

# Results



# Proposed Framework

- Mesh-based Photography Composition Transfer
  - A: Salince Detection
  - B: Mesh Construction
  - C: Two stage Graph matching
    - 1. Match of foreground object
    - 2. Match of background mesh

