Color transfer

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Problem Description

- **REGULARIZATION OF TRANSPORTATION MAPS FOR COLOR AND CONTRAST TRANSFER**

T: global optimal transportation

$$\mathcal{M}(u) = T(u) - u.$$

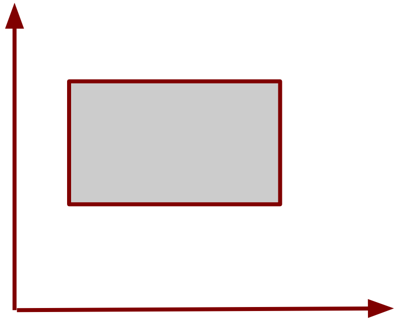
$$[\mathrm{Y}_u \mathcal{M}(u)](x) = \frac{1}{C(x)} \int_{y \in \mathcal{N}(x)} [\mathcal{M}(u)](y) \cdot e^{-\frac{\|u(x)-u(y)\|^2}{\sigma^2}} dy$$

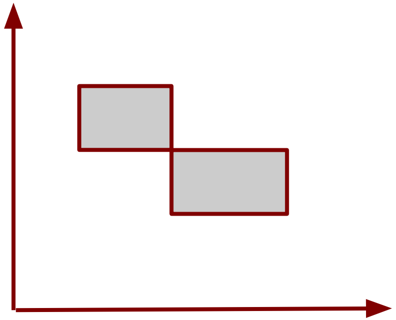
$$C(x) = \int_{y \in \mathcal{N}(x)} e^{-\frac{\|u(x)-u(y)\|^2}{\sigma^2}} dy \, .$$

$$\mathrm{TMR}_u(T(u)) := u + \mathrm{Y}_u \mathcal{M}(u)$$

Problem Description

- Suspect lαβ is not enough!





Finding Optimal Map: Rotation

- Why do we need rotation?

  to find the global optimal map T so that we can apply TMR

  (deal with localization later

- Get Rotation Matrix :

```
rx = [1 0 0;
    0 cos(tx) sin(tx);
    0 -sin(tx) cos(tx)];
ry = [cos(ty) 0 -sin(ty);
    0 1 0;
    sin(ty) 0 cos(ty)];
```

```
rz = [cos(tz) sin(tz) 0;
    -sin(tz) cos(tz) 0;
    0 0 1];
out = rx * ry * rz;
```

Method Overview: First Approach

1. Rotation + Histogram Equalization
   % to have correct T's from any angle
2. TMR

=> Nice Results!

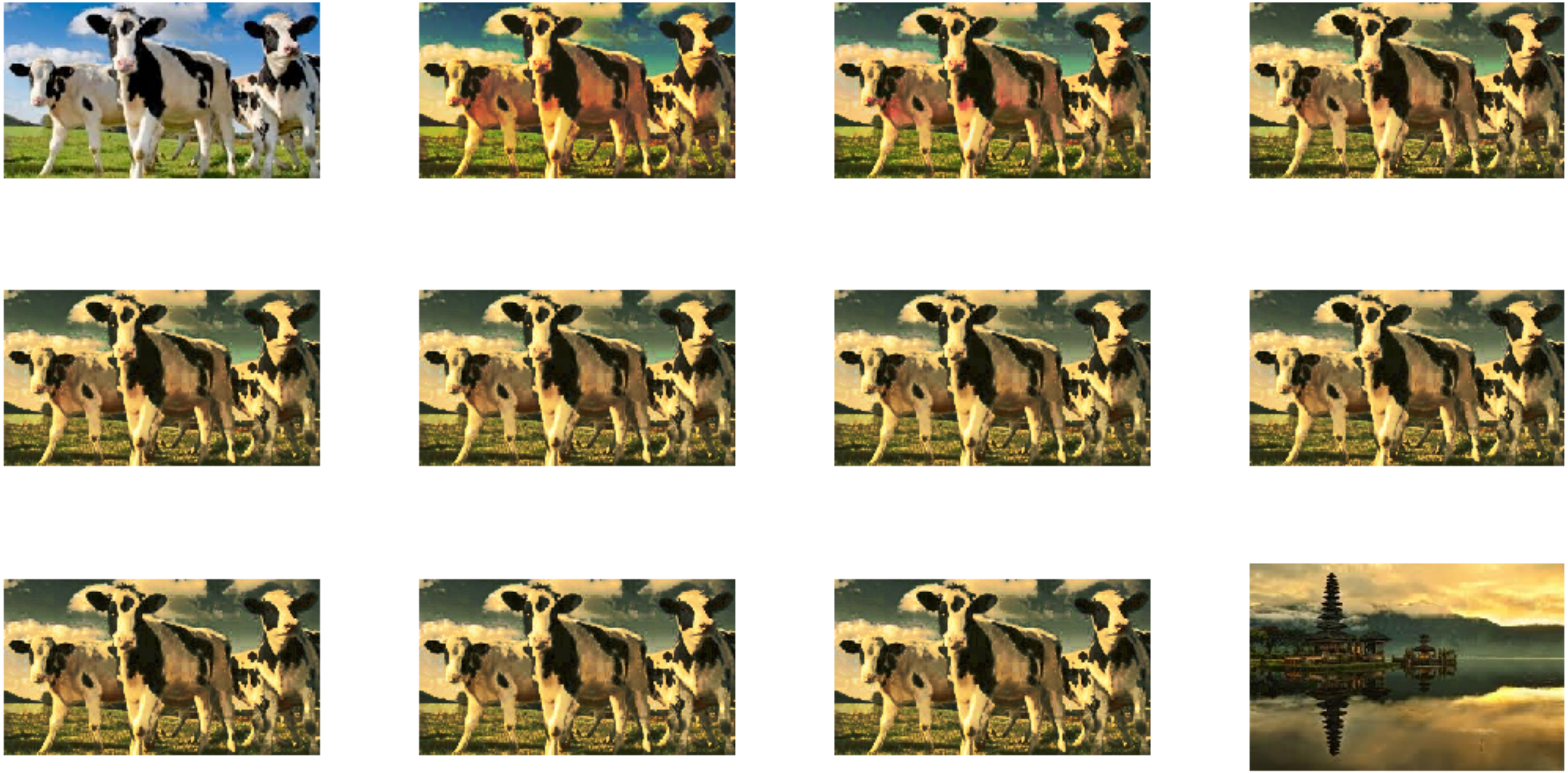
Source

First iteration

2nd iteration

result

Color Map



Effect of TMR: N.hood too small

Method Overview: 2nd Approach

~~1. K means clustering~~

1. FCM clustering
2. Cluster color mapping

    step 1: cluster histogram equalization

    step 2: TMR

Clustering: FCM

Each point has three dimensions (RGB)

FCM -- EM algorithm

Initialize: randomly assign a cluster label to each point

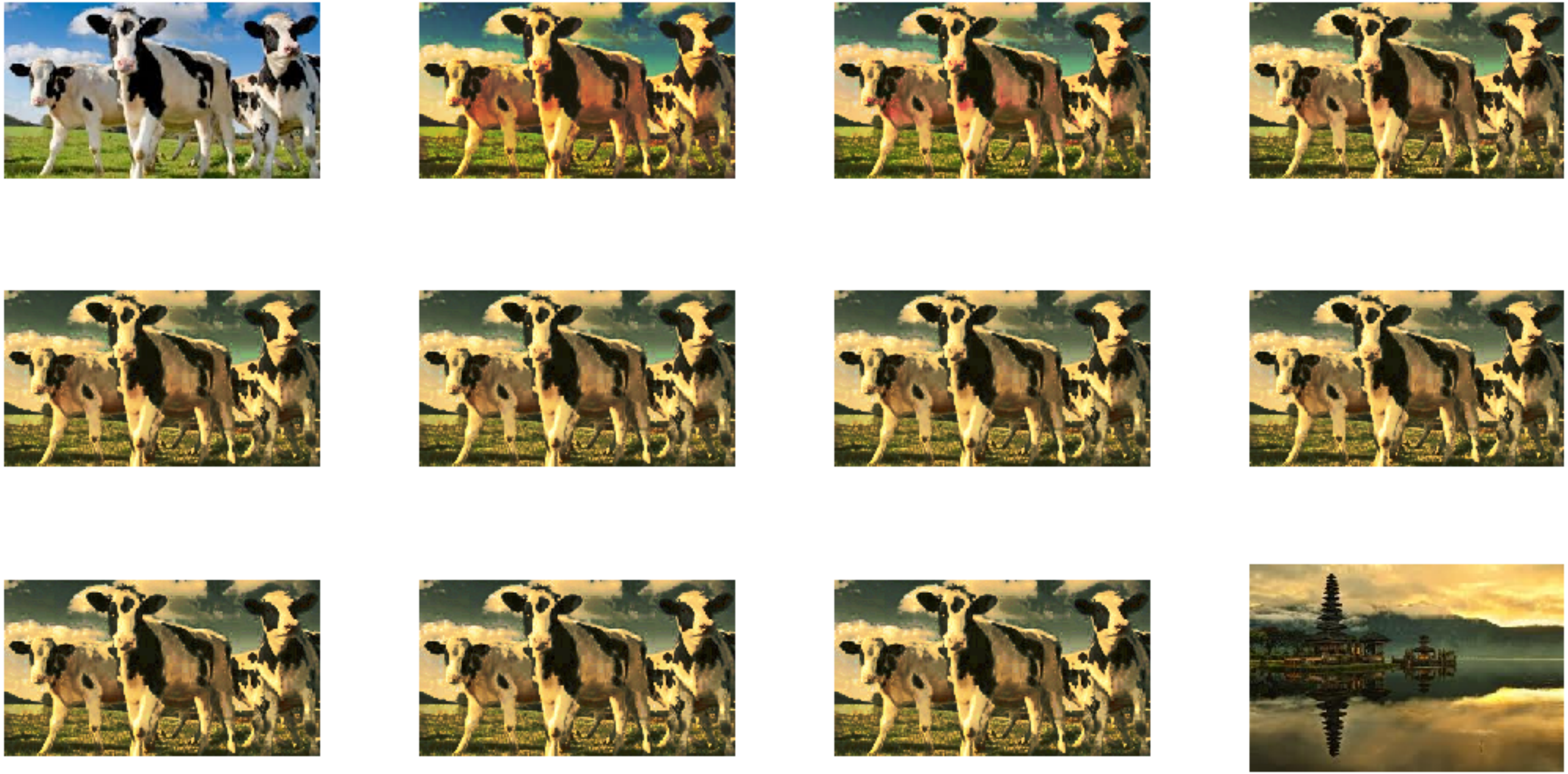
Iteration:

1. Use points in each cluster to calculate individual cluster mean and covariance matrix
2. For every point , reassign weights to each cluster by likelihood

Cluster color transfer:

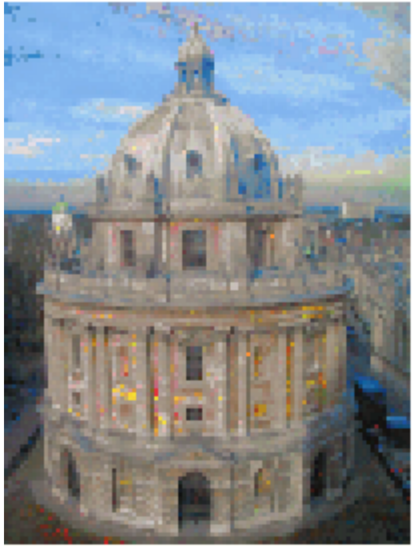
Source Cluster maps to 顏色距離最近的 map cluster (by cluster center

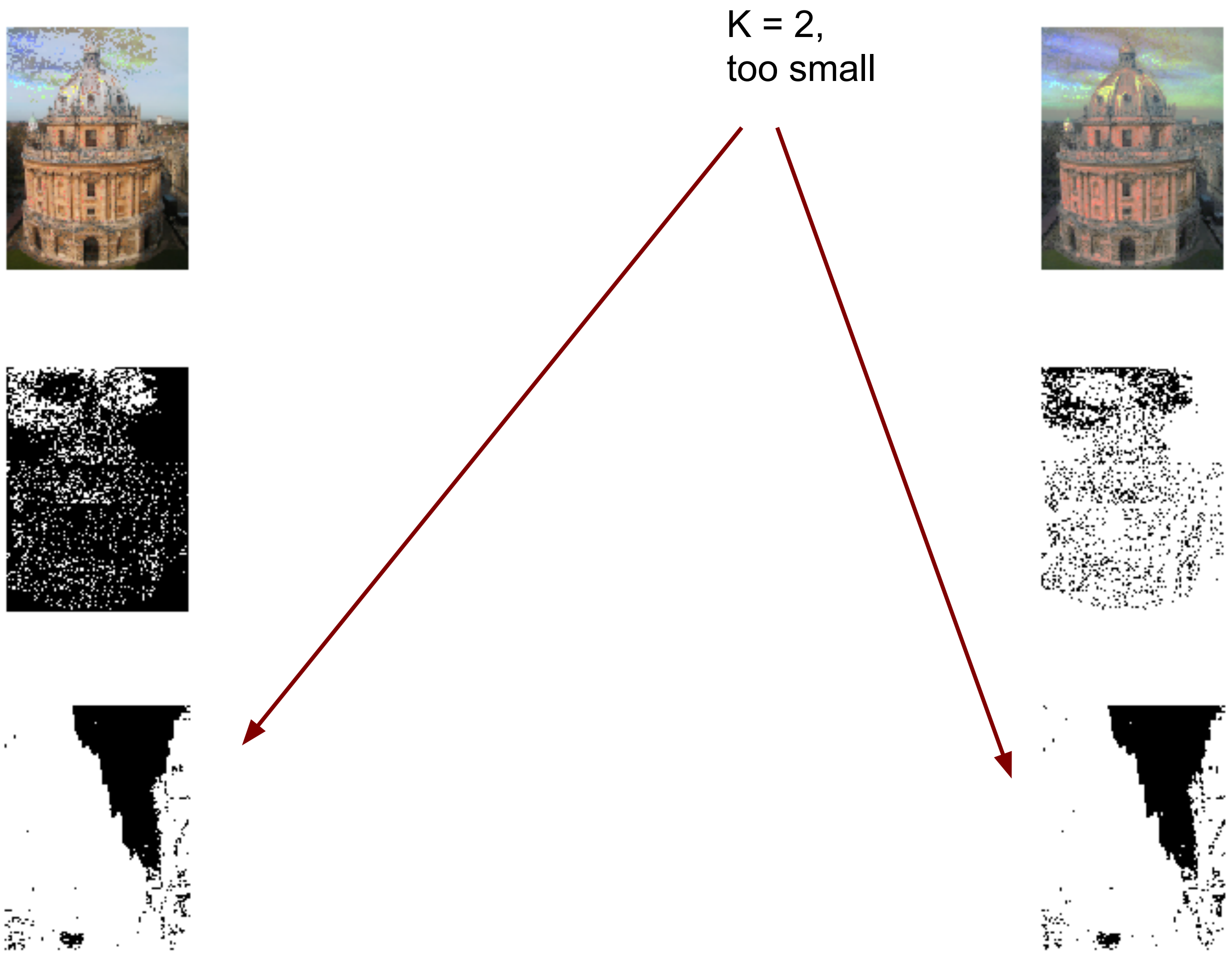
用 TMR 和旋轉座標 把兩個cluster做 histogram equalization



K=2

K太小的悲劇




K = 2,
too small

Problems:

1. Smoothing cluster map - Small clusters result in noise transfers
   Attempt:
   Smooth map clusters,
   For each point in cluster map, let neighbors vote it’s label
   => attempt failed
2. How big should K be ? (previous slide
   Sol: trial and error
3. Cluster initialization in EM algorithm (?
4. Optimal transfer map
   Sol:
   Rotate RGB axis and do equalization with each coordinate system,
   Hoping the result would converge to the global optimal transfer map

Future Work:

try on l-alpha-beta color space

Related Papers

1. J. Rabin, J. Delon, and Y. Gousseau, “**REGULARIZATION OF TRANSPORTATION MAPS FOR COLOR AND CONTRAST TRANSFER”,**Proc ICIP 2010

2. X.Huo, J.Tan, R.Jang**, “Color Transfer Based on Combining Subtractive Clustering with FCM Clustering”,**2007 IEEE
3. F. Pitie, A. Kokaram, and R. Dahyot, “Automated colour grading using colour distribution transfer,” Computer Vision andImage Understanding, February 2007.