



Panoramic image mosaics

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Outline

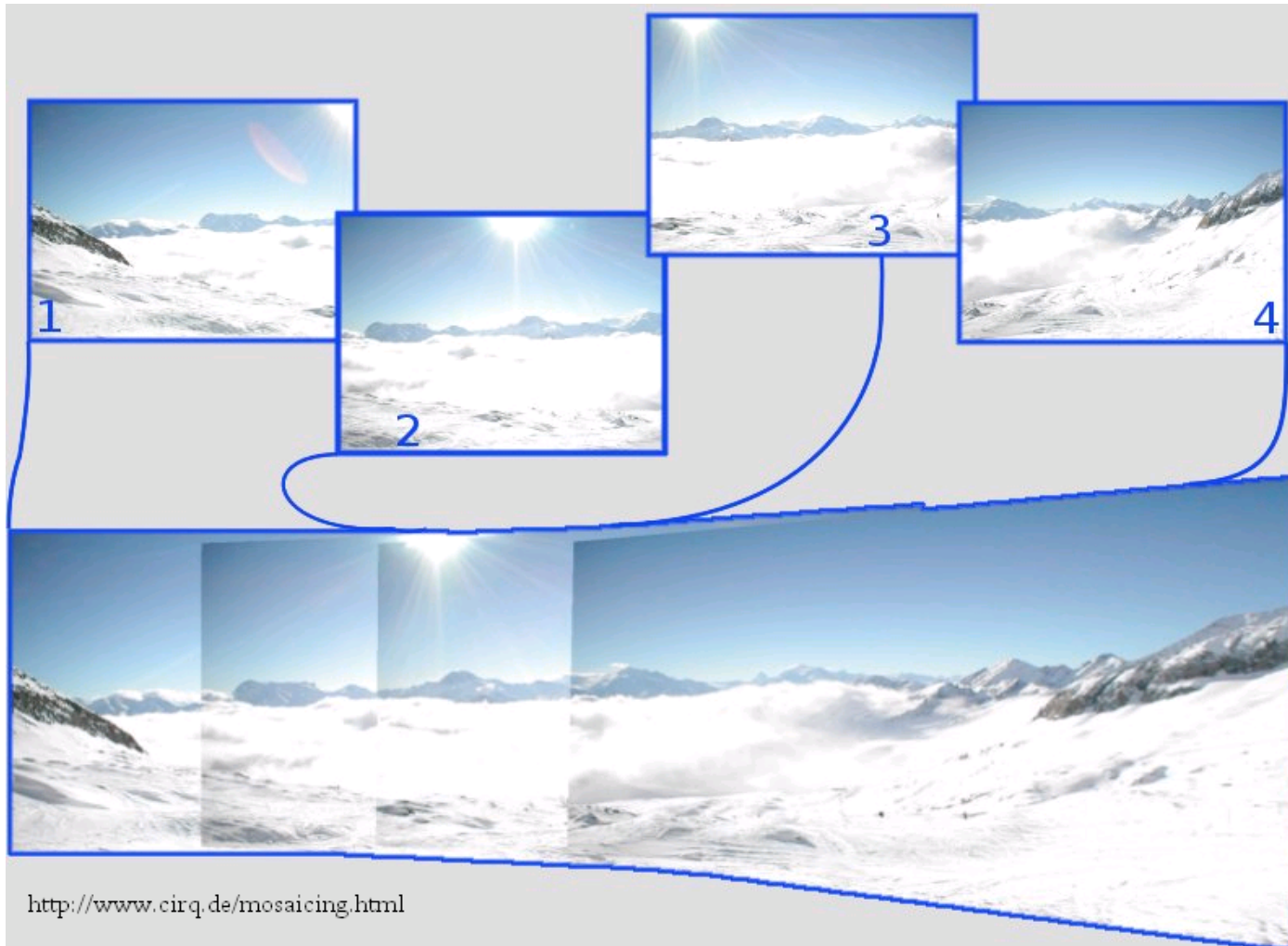
- ◆ Image mosaics
- ◆ Cylindrical and spherical panoramas
- ◆ Cylindrical panoramas description
- ◆ Panoramic image mosaics according to Szeliski
Shum
- ◆ Resources

Image mosaics

- ◆ Sequence of overlapping images
- ◆ Concat in space context (register)
- ◆ Movement of camera is context
- ◆ Every image is part (mosaic) of the result
- ◆ Problem: how to transform, find correct concat places



Image mosaics





Cylindrical and spherical

- Cylindrical and spherical panoramas:
- Assume fixed position of camera
- Rotation around optical center of camera



Cylindrical Panoramic image mosaics description

- ♦ Cylindrical Panoramas:
- ♦ Fixed position
- ♦ Rotation around vertical axis
- ♦ Idea: map images onto a cylinder
- ♦ Overlapping areas should be equal
- ♦ 360° panoramas



Cylindrical Panoramic image mosaics description

- ♦ Focal length or field of view has to be known
- ♦ Estimate projection plane (world coordinates)
- ♦ Map onto cylinder by using:

$$\theta = \tan^{-1}(X/Z), \quad v = Y/\sqrt{X^2 + Z^2}$$

- ♦ theta: panning angle, v : scanline
- ♦ Transform back into plane
- ♦ warp images – translation problem



Cylindrical Panoramic image mosaics description



(a)



(b)

Construction of a cylindrical panorama: (a) two warped images; (b) part of cylindrical panorama composited from a sequence of images.

From :Creating Full View Panoramic Image Mosaics and Environment Maps
Richard Szeliski and Heung-Yeung Shum



Cylindrical Panoramic image mosaics description

- ♦ Translation: based on concept move images along x axis
- ♦ in practice also little translations on y axis
- ♦ Estimate translation by minimizing intensity-Error in overlapping area

$$E(\delta\mathbf{t}) = \sum_i [I_1(\mathbf{x}'_i + \delta\mathbf{t}) - I_0(\mathbf{x}_i)]^2,$$

where $\mathbf{x}_i = (x_i, y_i)$ and $\mathbf{x}'_i = (x'_i, y'_i) = (x_i + t_x, y_i + t_y)$ are corresponding points in the two images, and $\mathbf{t} = (t_x, t_y)$ is the global translational motion field which is the same for all pixels



Cylindrical Panoramic image mosaics description

- ◆ Disadvantages of cylindrical and spherical panoramas:
- ◆ handles only rotation
- ◆ ill – sampling at poles (registration errors)
- ◆ need the focal length (or field of view)



Panoramic image mosaics

- ◆ Szeliski and Shum: 3-parameter rotational model
- ◆ Properties: relative (not absolute) fixed position of camera – may move a bit
- ◆ Need to know order of pictures
- ◆ Overlapping area is flexible
- ◆ Camera direction is flexible
- ◆ Focal length is calculated



Panoramic image mosaics

- ♦ Idea: for every image create a matrix
- ♦ 3-parameters: rotation, focal length, translation
- ♦ a 3d point $p = (X, Y, Z)$ is related to an image point $x = (x, y, 1)$ by $x \sim TVRp$
- ♦ Get rid of T by assuming image origin in the middle



Panoramic image mosaics

- ♦ Mapping between pixels from image k and l :

$$M \sim V_k R_k V_l^{-1} R_l^{-1}$$

- ♦ Calculate M between every two images...
- ♦ Get from image to image 3x3 Matrix, M describes camera rotation
- ♦ focal length also calculated in algorithm...

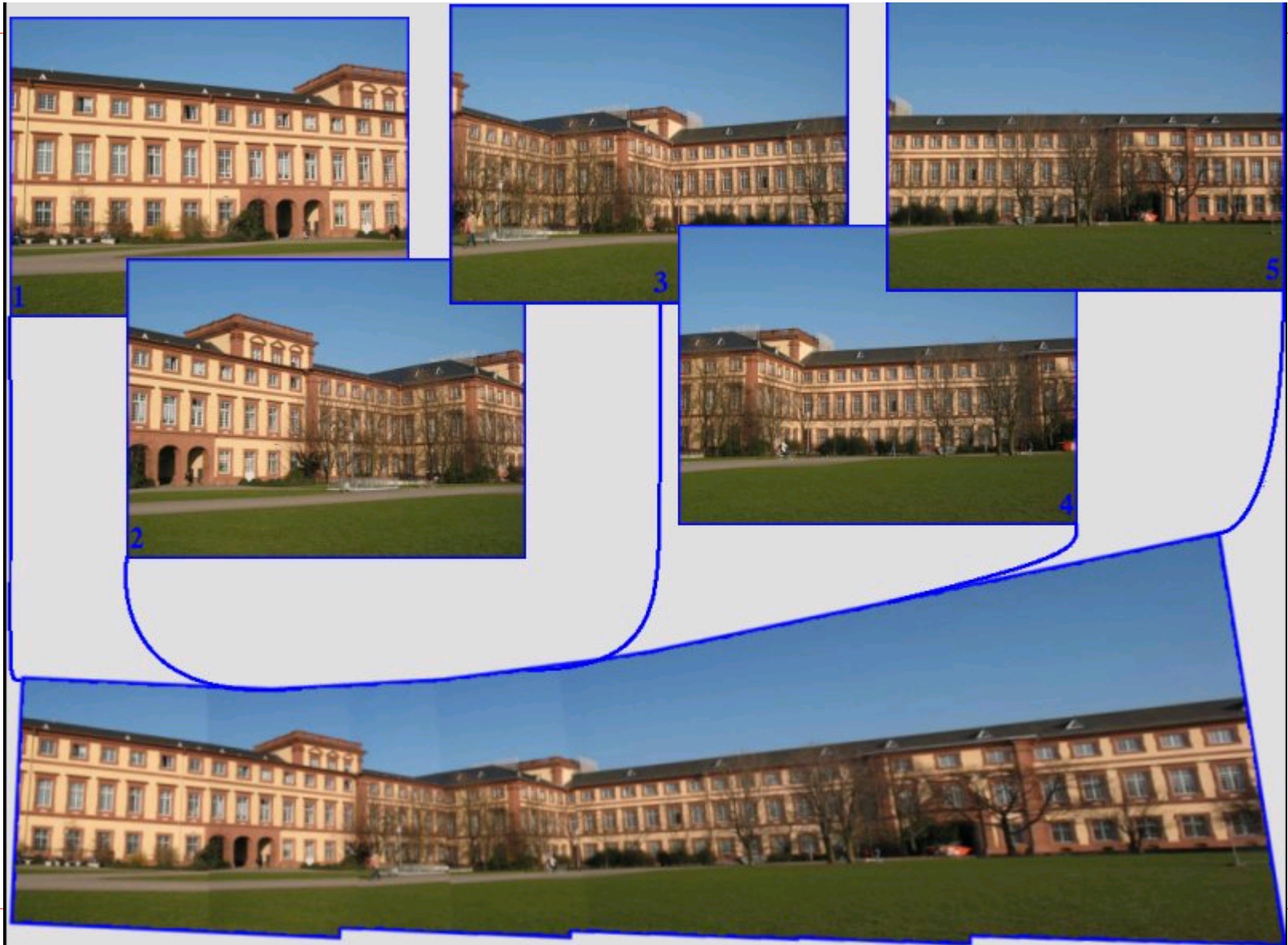


Panoramic image mosaics

- ◆ Apply specific M on image
- ◆ Project all onto a plane \Rightarrow panorama
- ◆ Technique for creating environment maps



Example



Resources

- ♦ Paper: Creating Full View Panoramic Image Mosaics and Environment Maps from Richard Szeliski and Heung-Yeung Shum
- ♦ <http://www.cirq.de/mosaicing.html#>