Image Processing

Project 3: Interpolation and Image Warping

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Contents

1 Radial Basis Function
- Radial Basis Function Interpolation

2 Warps

3 Cylinder anamorphosis

4 Transformation of coordinates

5 Perspective Mapping Between Quadrilaterals

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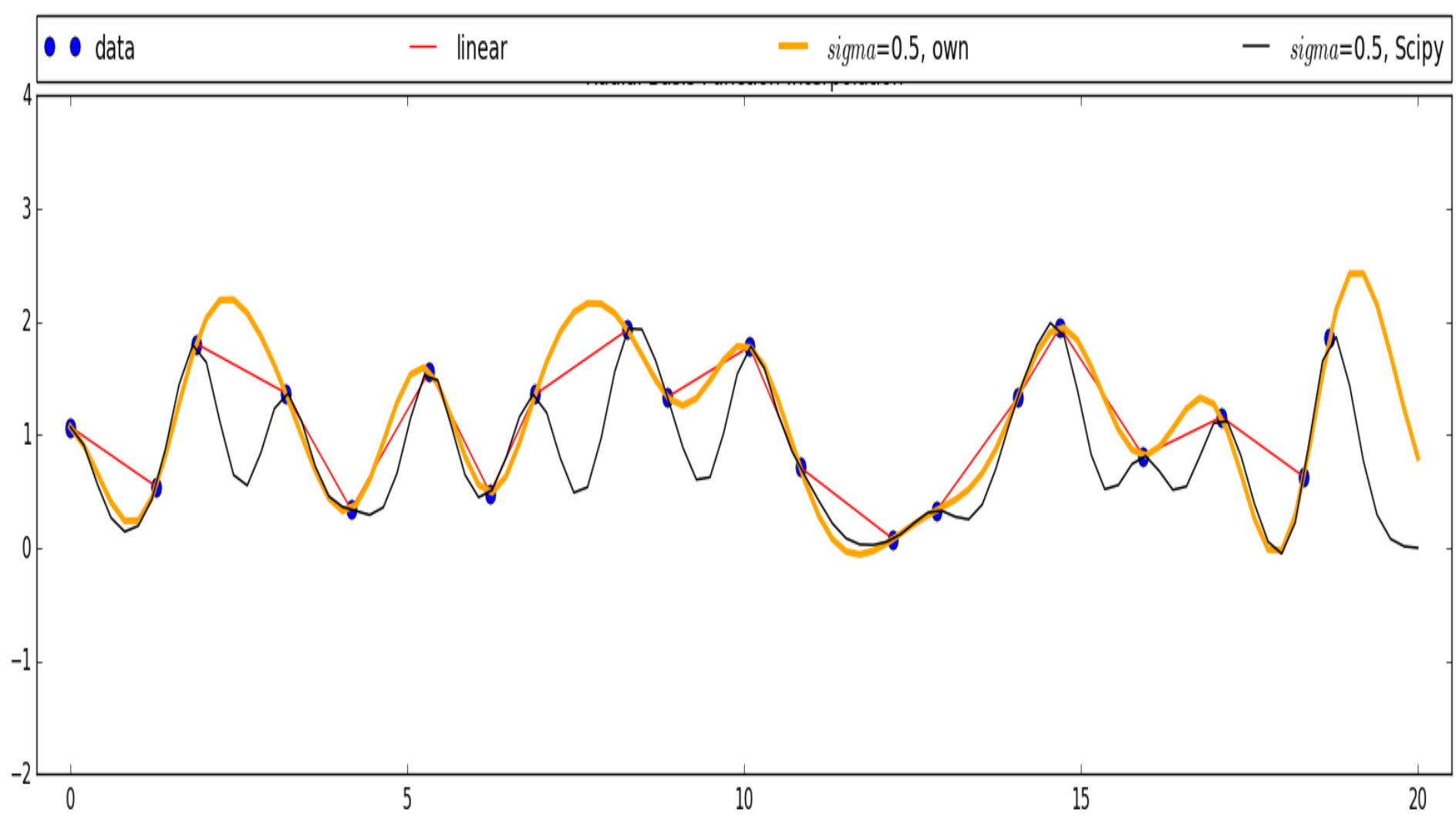
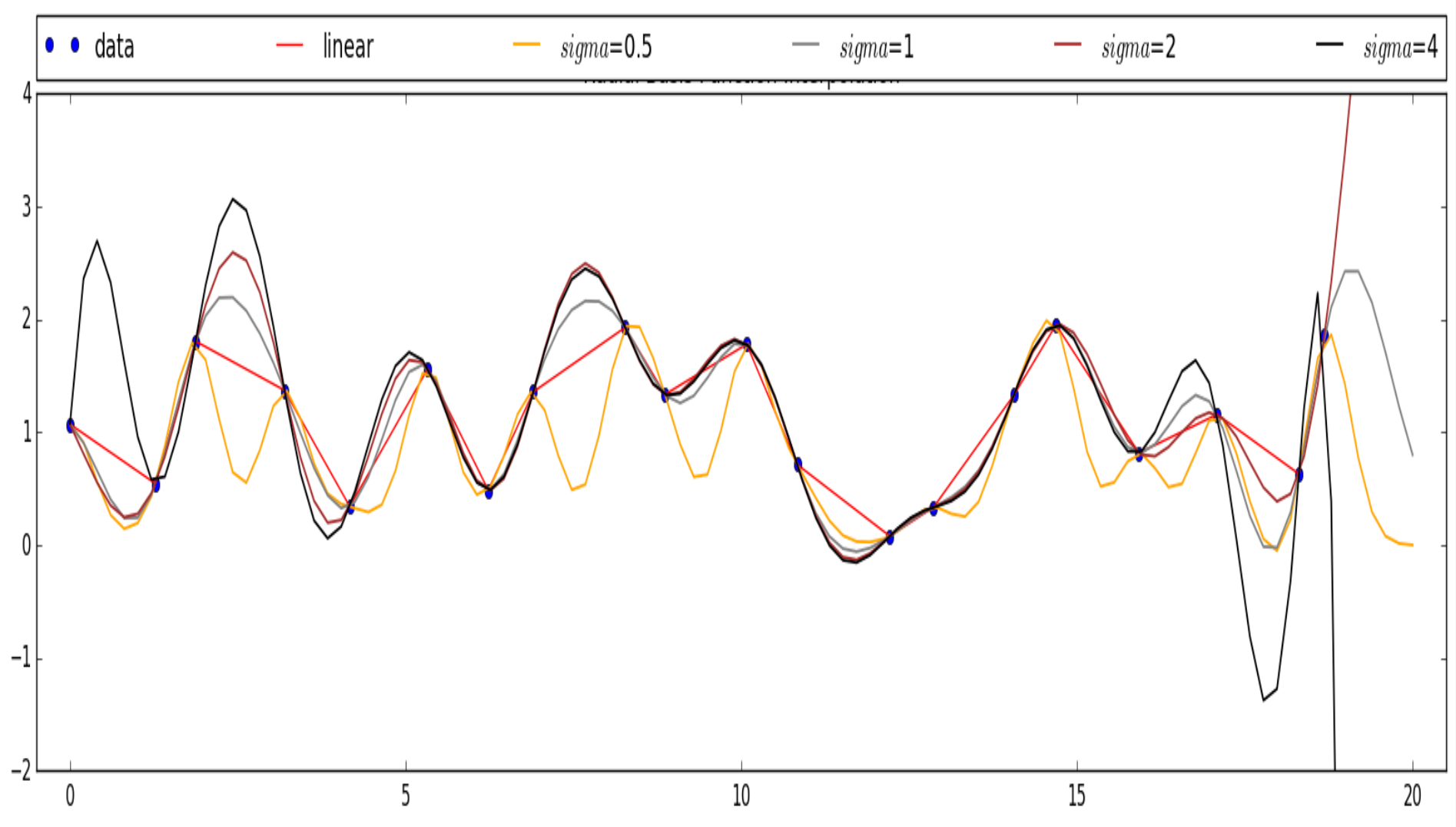
Radial Basis Function Interpolation

- We are using a Gaussian solution, but, there are other different option:
  - Multiquadratic (most common, by default in Scipy)
  - Inverse multiquadratic
  - Thin-plate spine
- We are reconstructing *unknown functions* from *known data*.
- Here, we look for weights w_i
- The solution is: $w = \phi^{-1} \cdot y$
- y is the vector of values we want to *learn*

Comparison with Scipy implementation



Different values for σ



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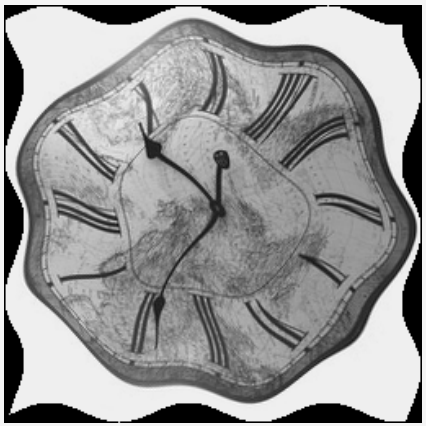
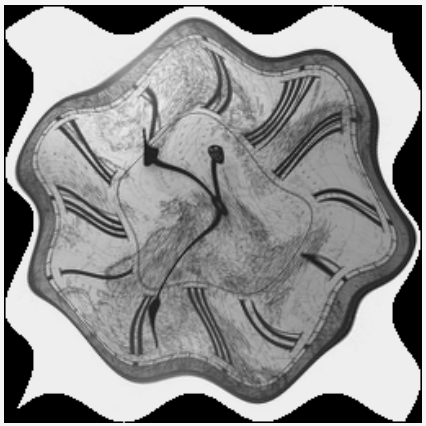
3.2. Warps (Changes in amplitude α)

(a) $\alpha_x = \alpha_y = 0$

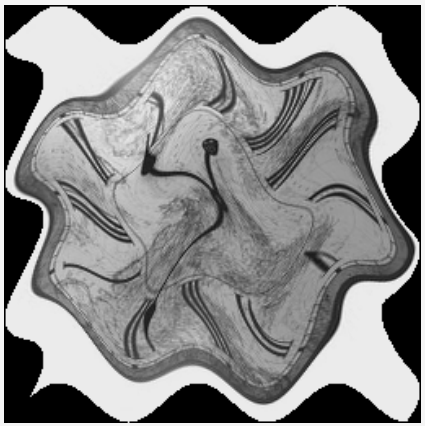
(b) $\alpha_x = \alpha_y = 3$



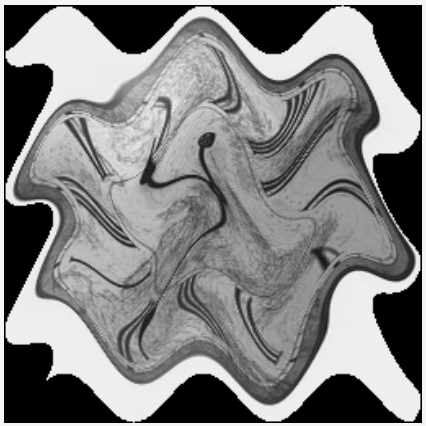
(c) $\alpha_x = \alpha_y = 6$



(d) $\alpha_x = \alpha_y = 9$

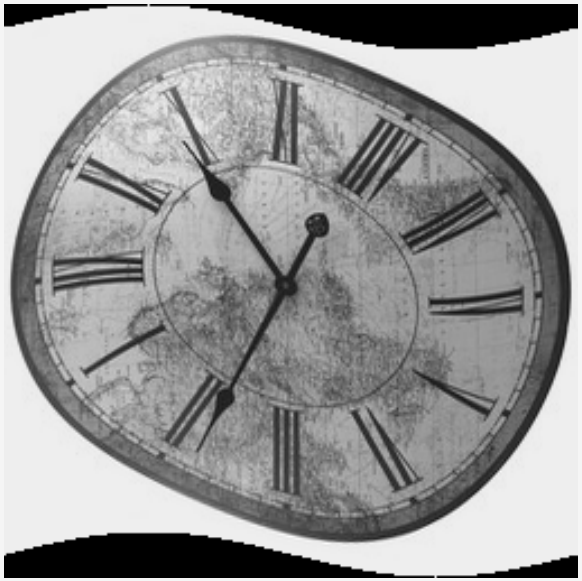


(e) $\alpha_x = \alpha_y = 12$



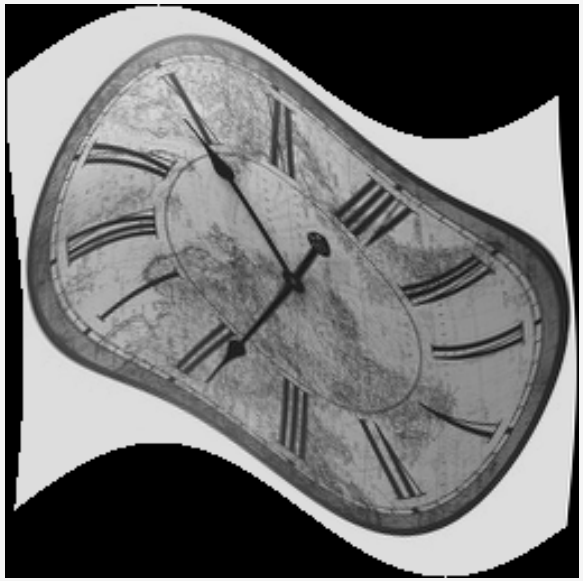
(f) $\alpha_x = \alpha_y = 15$

3.2. Warps (Amplitude $\alpha_x \neq \alpha_y$)



(g) $\alpha_x = 10, = \alpha_y = 0$

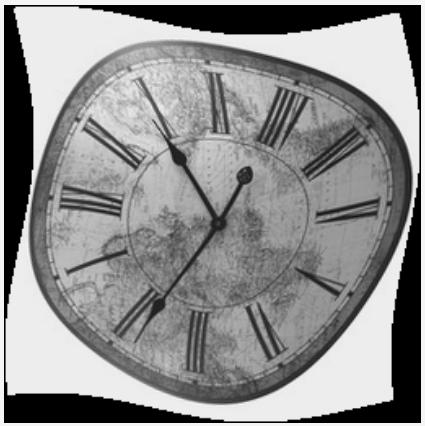
(h) $\alpha_x = 4, = \alpha_y = 30$



(i) $\alpha_x = 30, = \alpha_y = 4$

3.2. Warps (Phase ϕ)

(j) $\phi = 10$

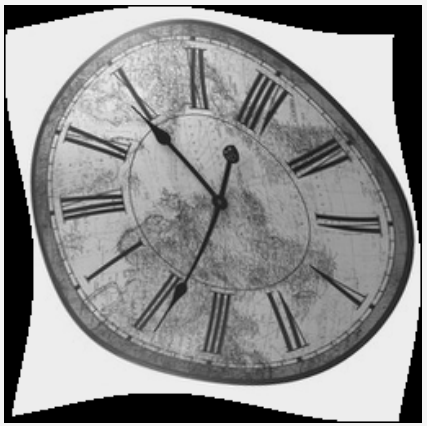


(k) $\phi = 20$

(l) $\phi = 40$

(m) $\phi = 60$

(n) $\phi = 80$



(o) ϕ =100

3.2. Warps (Phase ϕ)

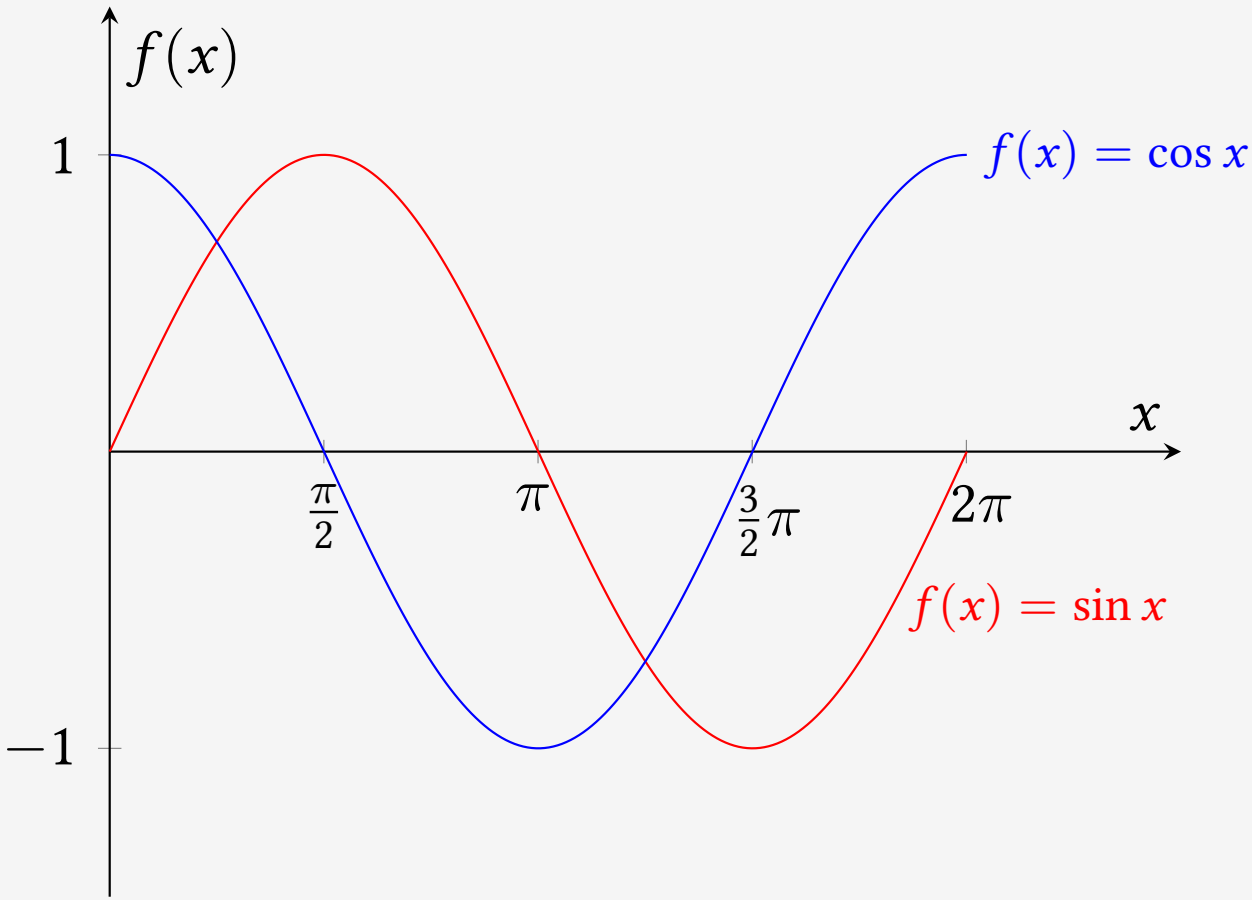
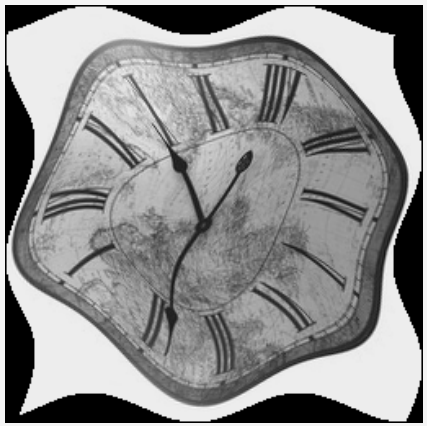
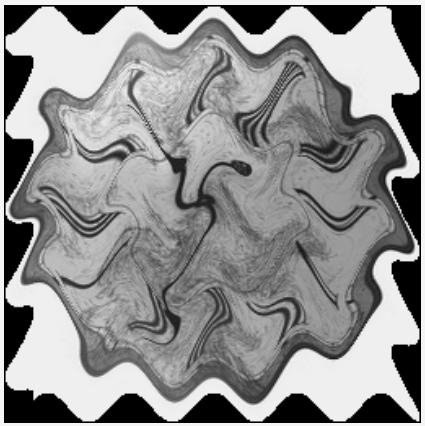


Figure: There is not difference at all!

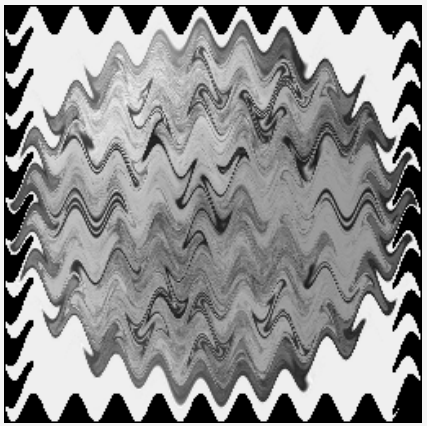
3.2. Warps (Frequency v)



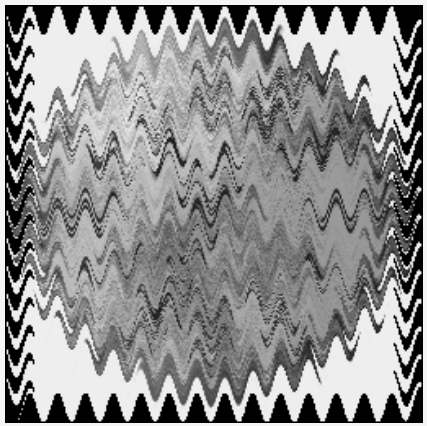
(a) $v = 2$



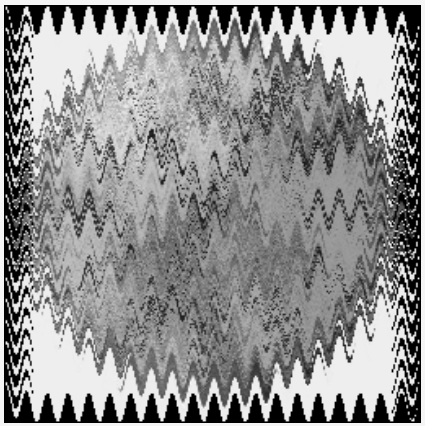
(b) $v = 5$



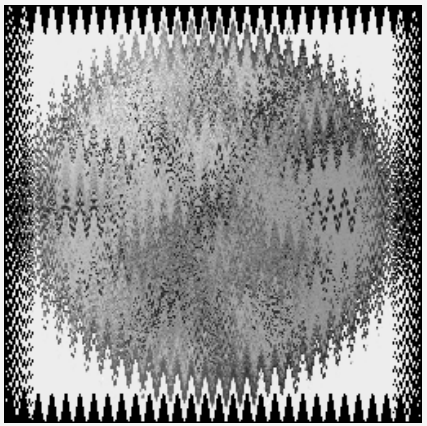
(c) $v = 10$



(d) $v = 15$

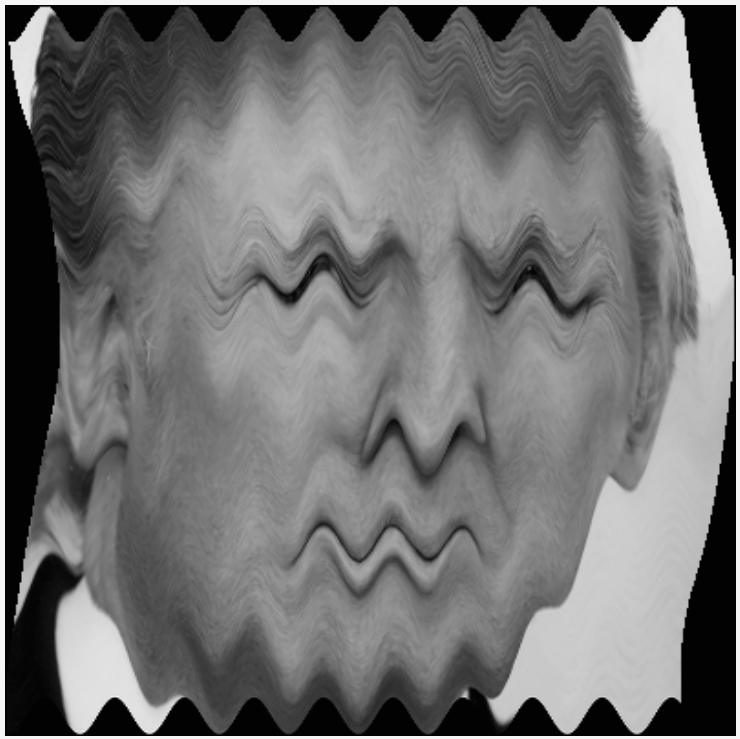


(e) $v = 20$



(f) $v = 30$

3.2. First combination



- $\alpha_x = 10, \alpha_y = 15$
- $\phi_x = 10.5, \phi_y = 1$
- $v = x$

3.2. Second combination

- $\alpha_x = 100, \alpha_y = 0$
- $\phi_x = 1, \phi_y = 0$
- $\nu = 4.66$, (infinite posibilities)

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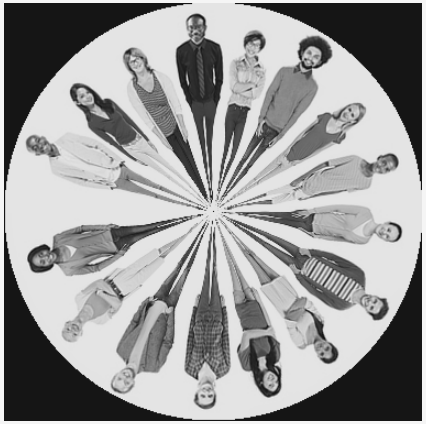
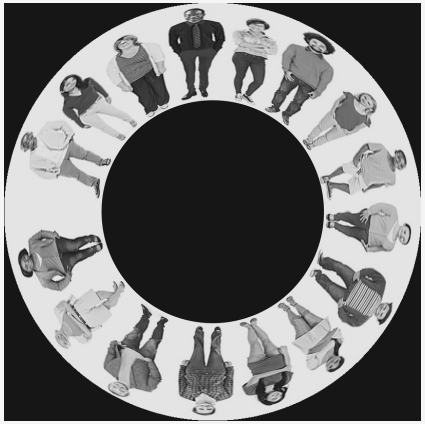
3.3. Cylinder anamorphosis

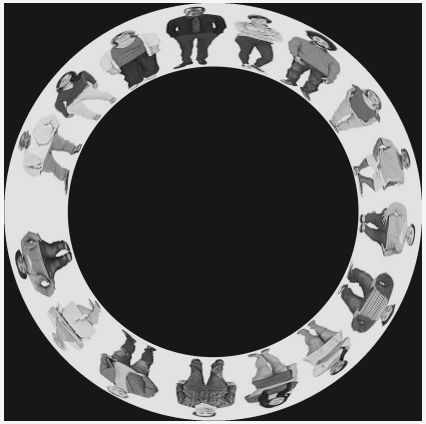
(g) Original



(h) Radius 0



(i) Radius 3



(j) Radius 6

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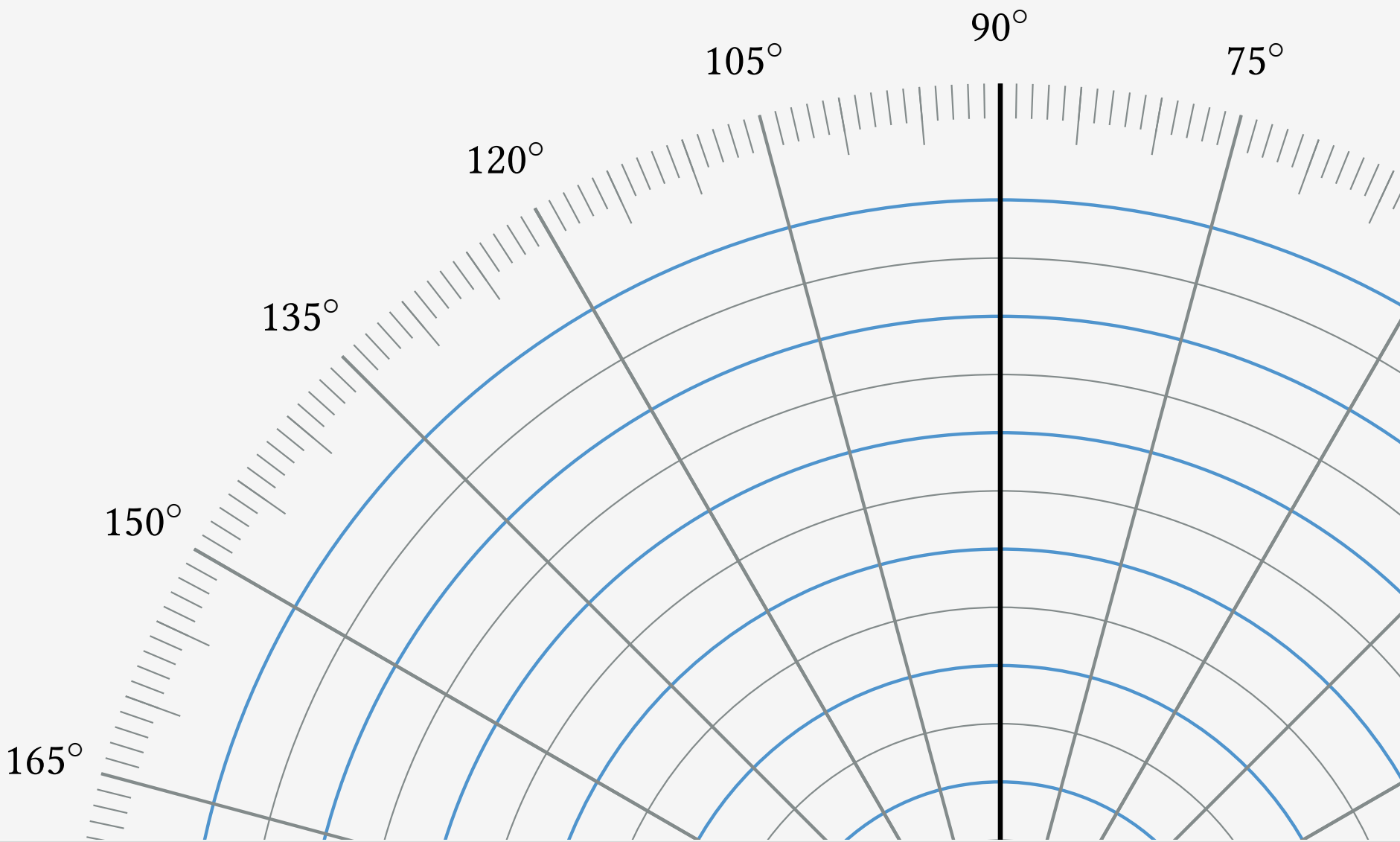
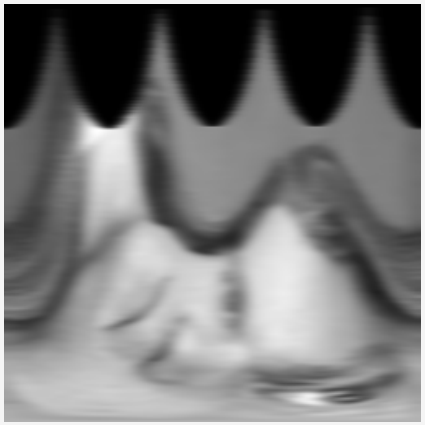
5 Perspective Mapping Between Quadrilaterals

Polar coordinates



3.4. Transformation of coordinates

(k) r, φ



(l) φ-axis blurred

(m) new x, y

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3.5. Perspective Mapping Between Quadrilaterals

- What is the main problem?
- Calculate the transformation matrix so our image fits inside the poster
- The solution is use *homography*.

3.5. Perspective Mapping Between Quadrilaterals

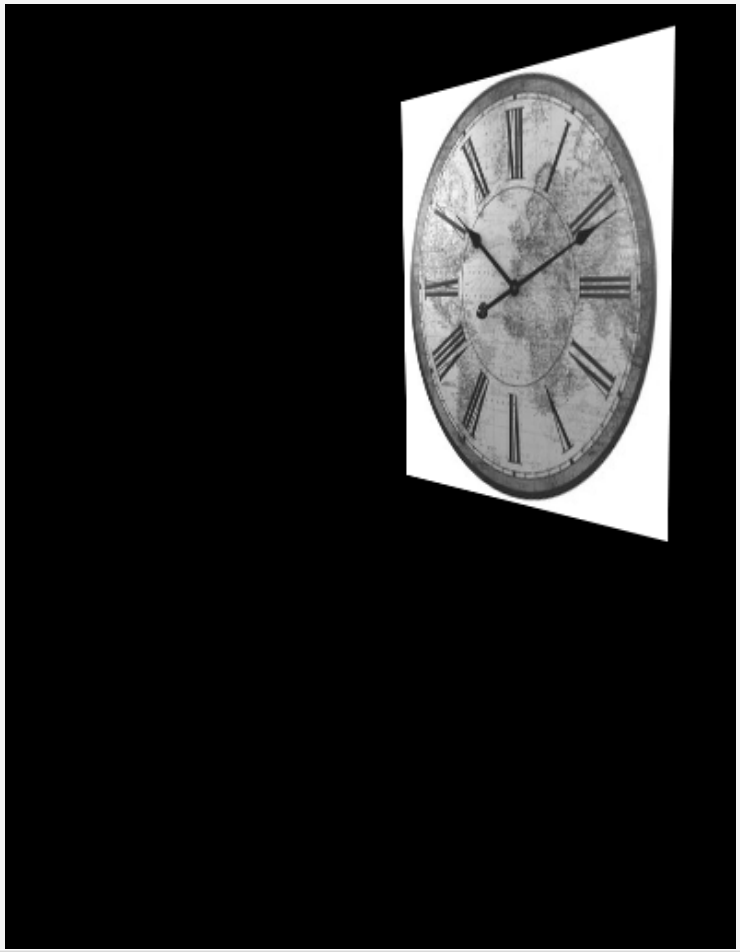
- What is homography?
- A homography is a transformation (a 3×3 matrix) that maps the points in one image to the corresponding points in the other image.

How to do it?

- 1. Load images

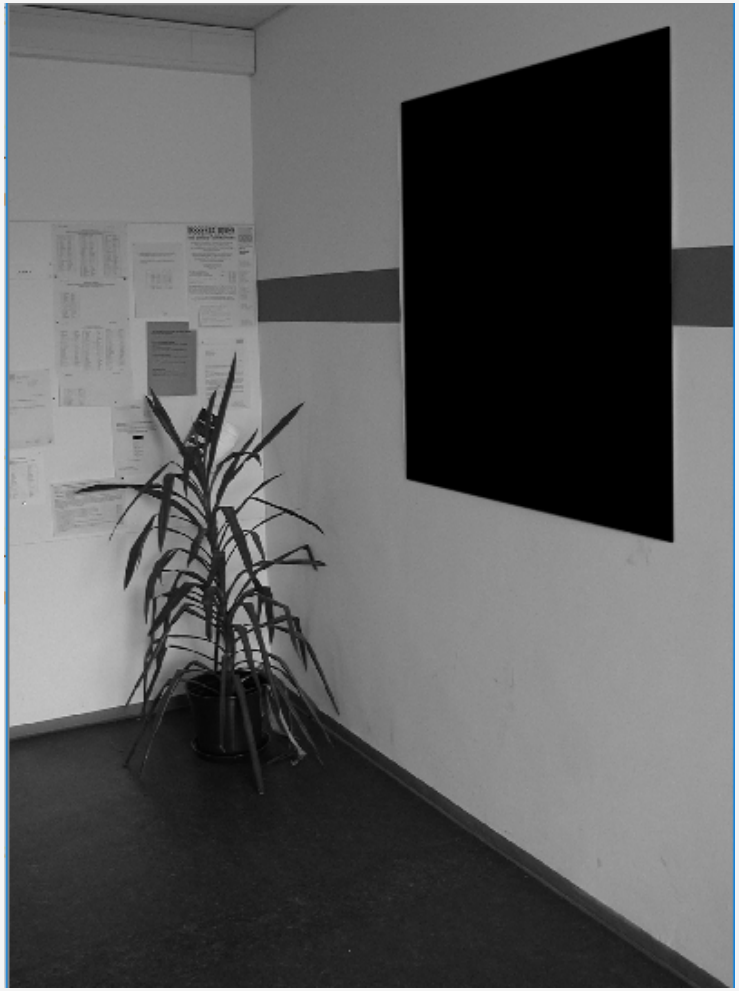
How to do it?

- 2. Define the corners where to put the small image
- 3. Calculate *homography* between source and destination points
- 4. Generate warped small image in an image size like the destination one



How to do it?

- 5. Black out polygonal area in destination image.



Results

- 6. Add warped source image to destination image.

Results


JERSEY BOYS
BEST MUSICAL
2006 TONY AWARD WINNER
WICKED
PHANTOM
ALDO
CONAN
TAPS STEAKS
Sbarro


JERSEY BOYS
BEST MUSICAL
2006 TONY AWARD WINNER
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ALDO
CONAN
TAPS STEAKS
Sbarro