Computational Photography

* Study the basics of computation and its impact on the entire workflow of photography, from capturing, manipulating and collaborating on, and sharing photographs.

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Digital Images: Merging and Blending Images

* Different methods for Combing Multiple Images to Generate a Novel Image

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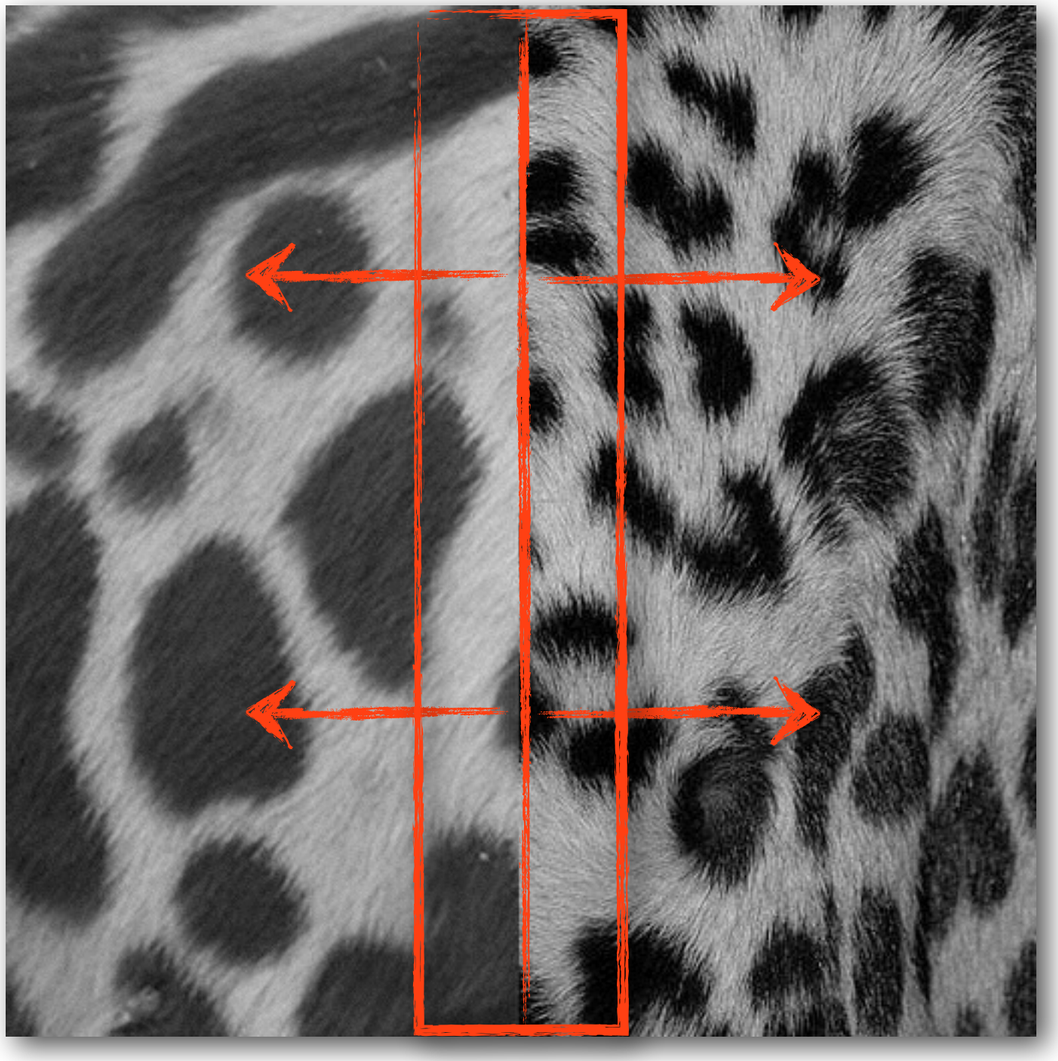
* merging two images
* Window sizes used for merging images
* Advantages of a using the Fourier Domain

Recall: Combine, Merge, Blend Images

Merging Two Images

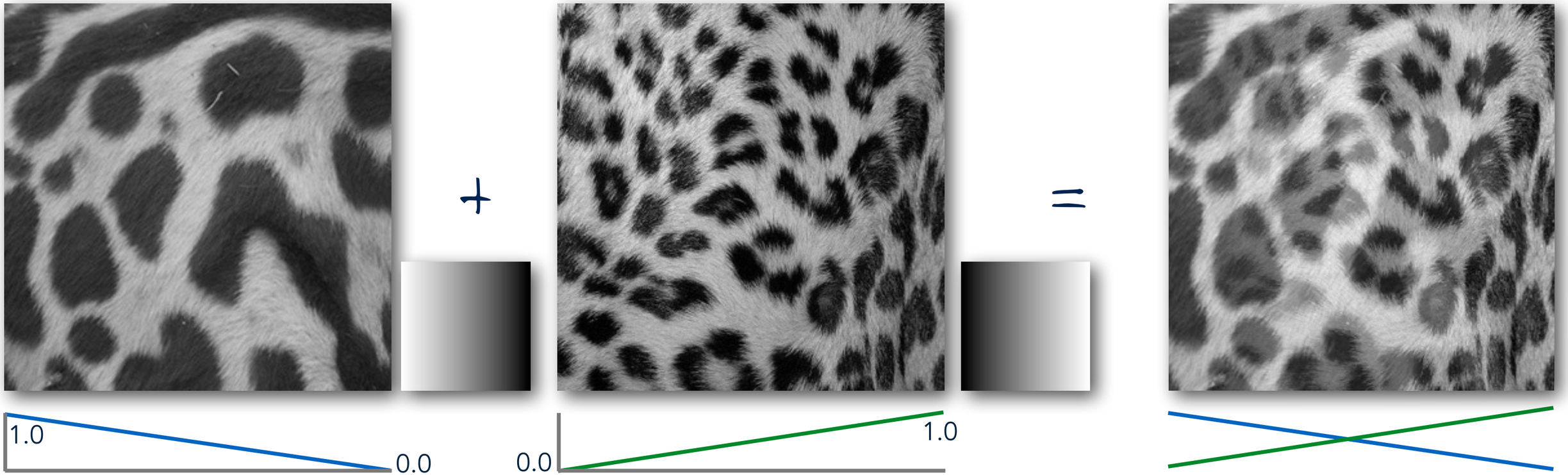
Merging Two Images

Merging Two Images

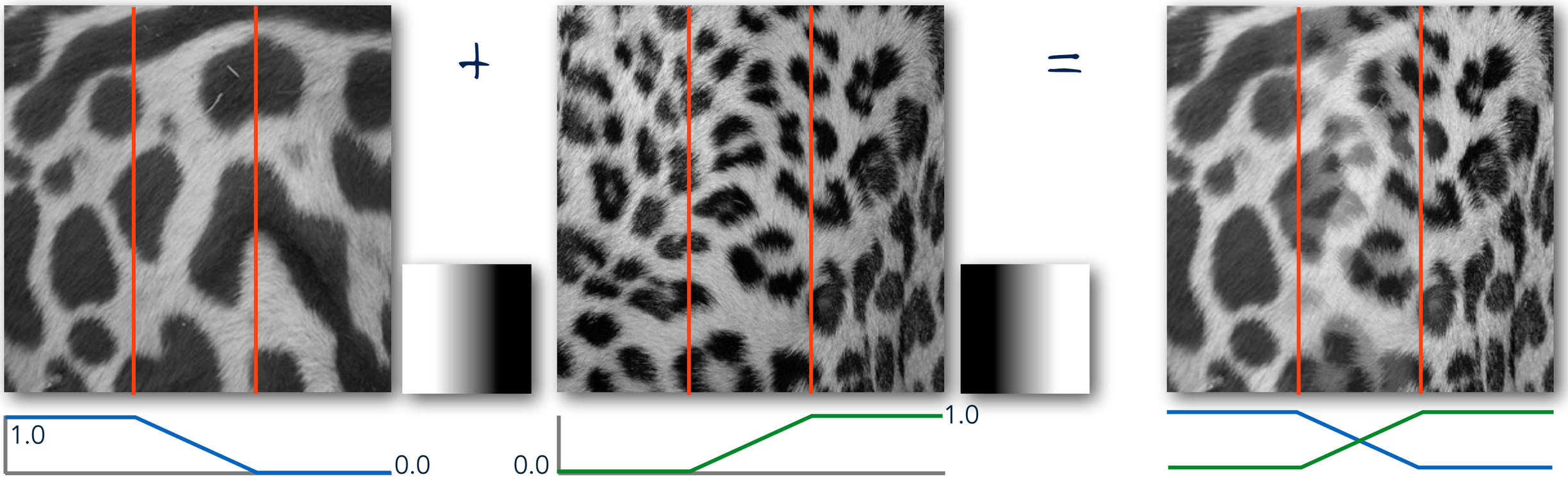


Cross-Fading Two Images

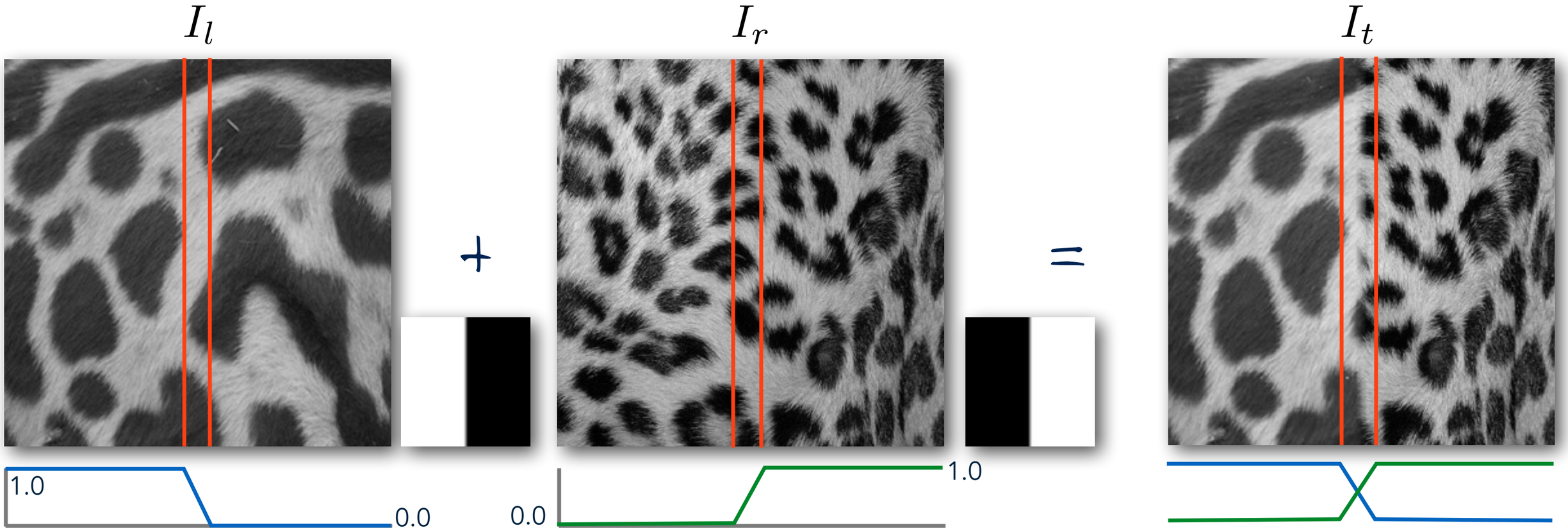
I_l I_r I_t



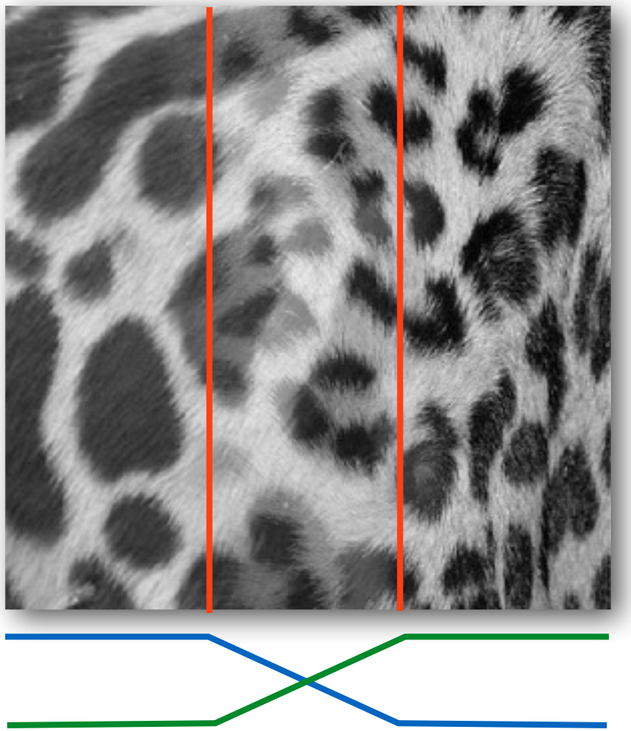
Cross-Fading Two Images

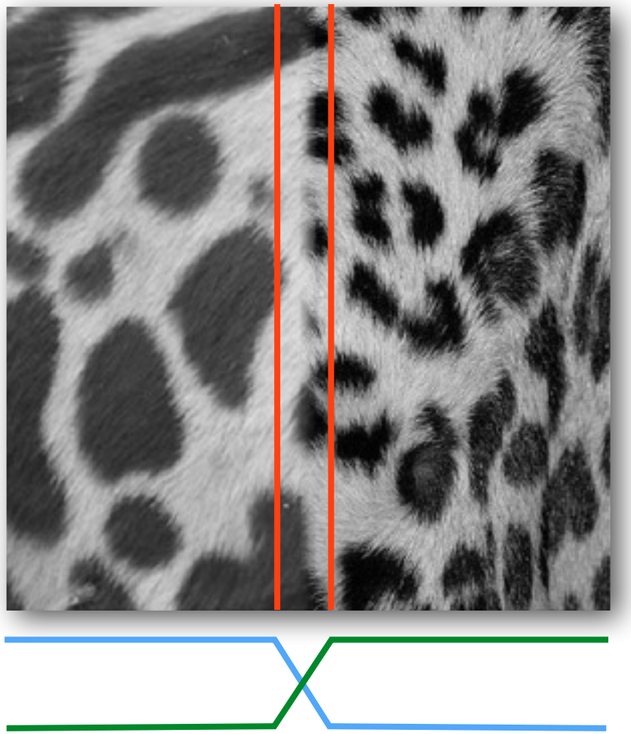


Cross-Fading Two Images

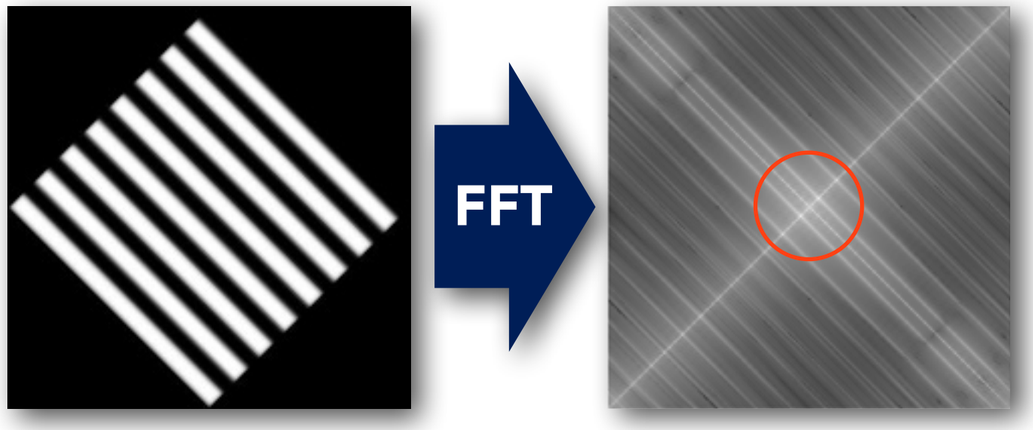


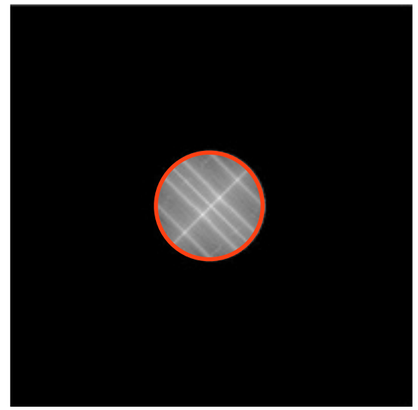
Cross-Fading Window Size

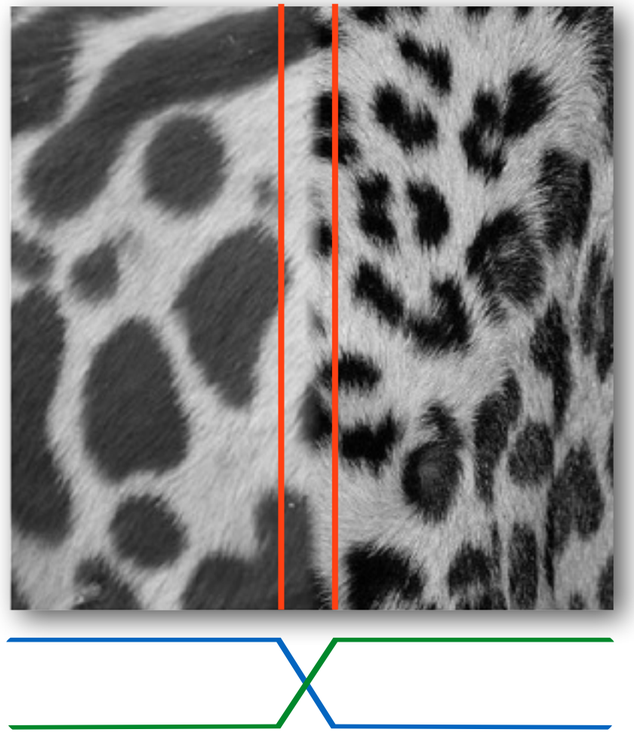




Factors for Optimal Window Size

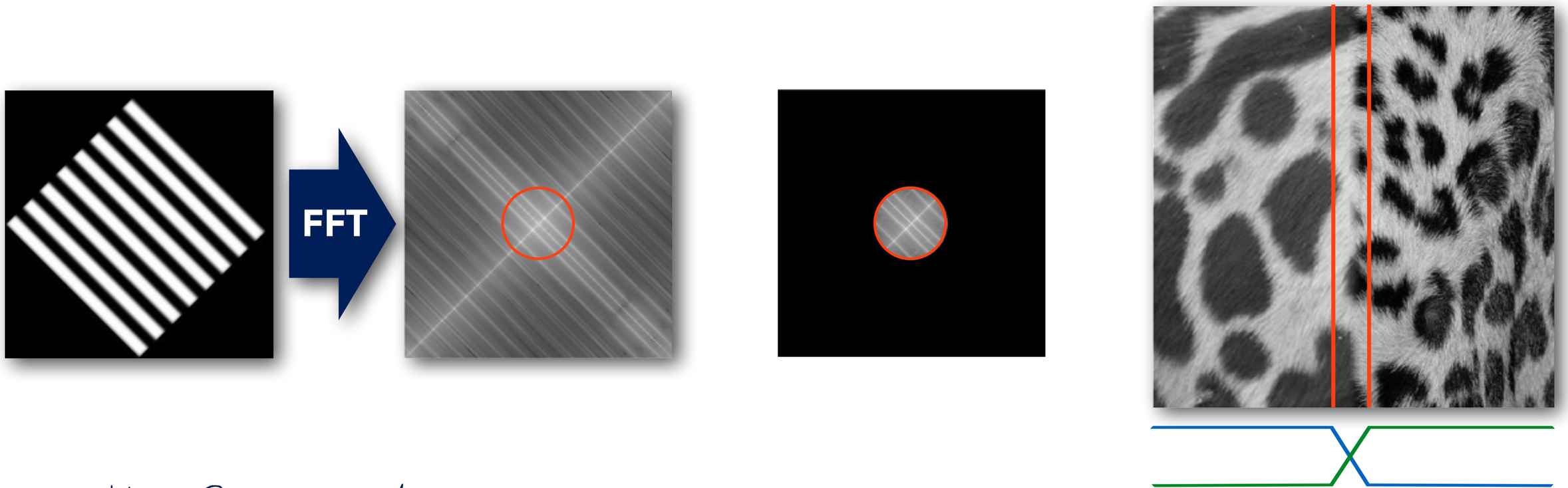






* To avoid seams: Window = size of largest prominent "feature"
* To avoid ghosting: Window $\leq 2\times$ size of smallest prominent "feature"

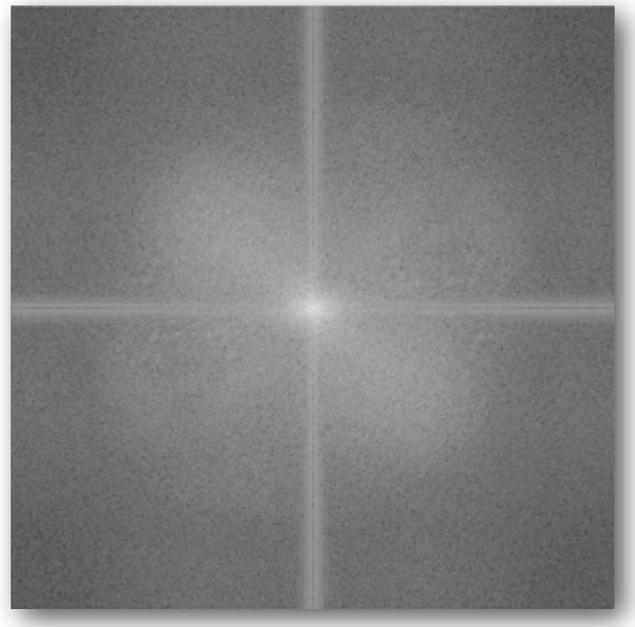
Factors for Optimal Window Size

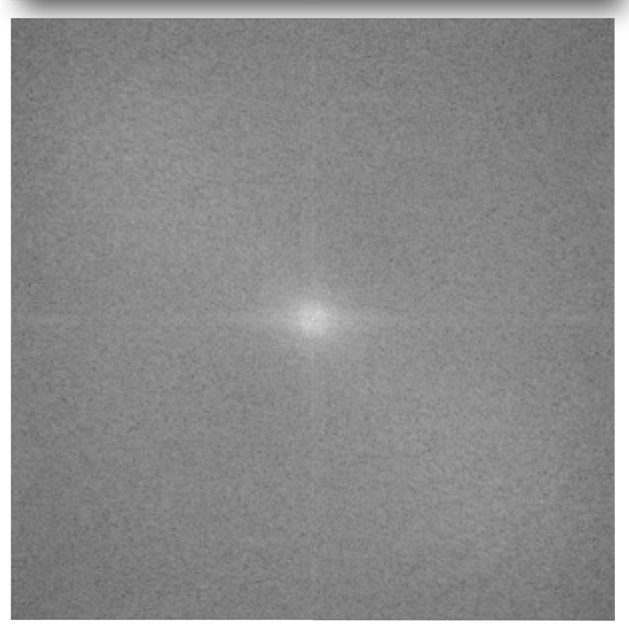


Use Fourier domain

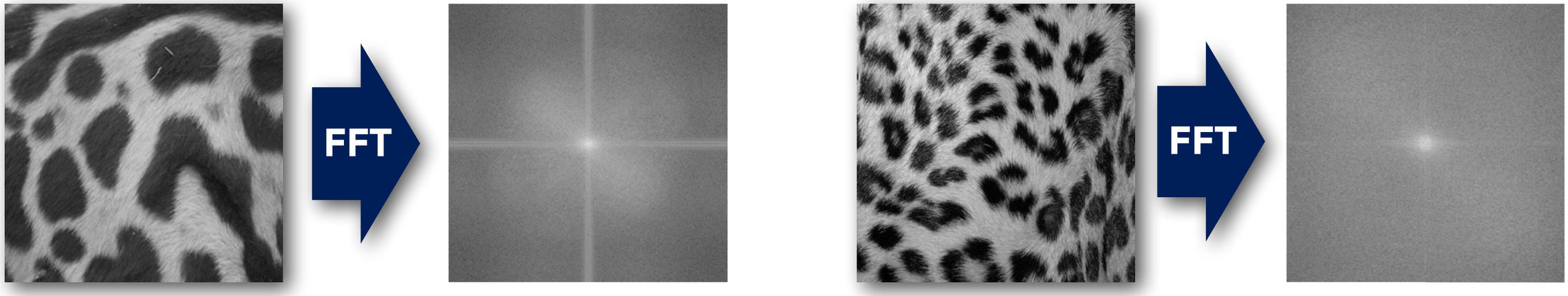
* Largest frequency $\leq 2 \times$ size of smallest frequency
* Image frequency content should occupy one "octave"
  * (power of 2)

Frequency Spread needs to be Modeled





Frequency Spread needs to be Modeled

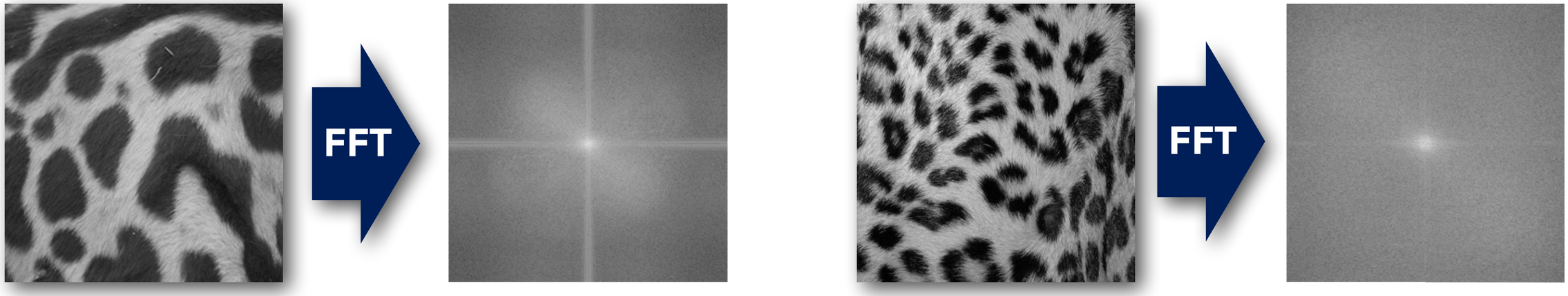


* Compute: $FFT(I_l) \Rightarrow F_l, \quad FFT(I_r) \Rightarrow F_r$

* Decompose Fourier image into octaves (bands)

$$F_l = F_l^1 + F_l^2 + F_l^3 + \ldots, \quad F_r = F_r^1 + F_r^2 + F_r^3 + \ldots$$

Frequency Spread needs to be Modeled



* "Feather" corresponding octaves of: F_l F_r
* Compute inverse FFT and feather in spatial domain
* Sum feathered octave images in frequency domain

Burt and Adelson (1983)

Feathering

* "Blur" the edges before applying the blend operations.
* Makes the blend, smoother.

Summary

* Merging two images
* Presented the two issues caused by not being able to determine the window used for merging images
* Presented the two advantages of a using the Fourier Domain

Next Class

* Merging and Blending of Images: Use of Pyramids

Credits

- For more information, see
  - Szeliski (2010) Computer Vision: Algorithms and Applications, Springer.
  - Burt and Adelson (1983) "The Laplacian Pyramid as a Compact Image Code", In IEEE Transactions on Communications, 31 (4). p 532-540. 1983 (DOI)
  - Burt and Adelson (1983) "A multiresolution spline with application to image mosaics". In ACM Transactions on Graphics, 2 (4). 1983 (DOI)
- Some concepts in slides motivated by similar slides by A. Efros and J. Hays.
- Some images retrieved from
  - http://commons.wikimedia.org/.
  - List will be available on website
  - by Irfan Essa

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* Study the basics of computation and its impact on the entire workflow of photography, from capturing, manipulating and collaborating on, and sharing photographs.

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