

# Analysis method: study images at different **scales**

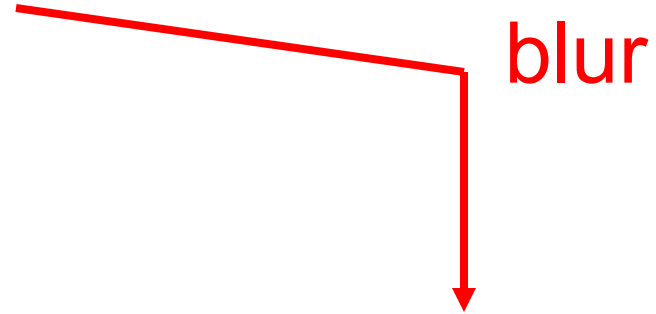
In particular:

- determine image content at different scales
- which information “lives” at different scales?
- find local hierarchical relationships governing information at these scales

# Determine information at different scales



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# Determine information at different scales



blur



and find the  
difference



# Determine information at different Scales



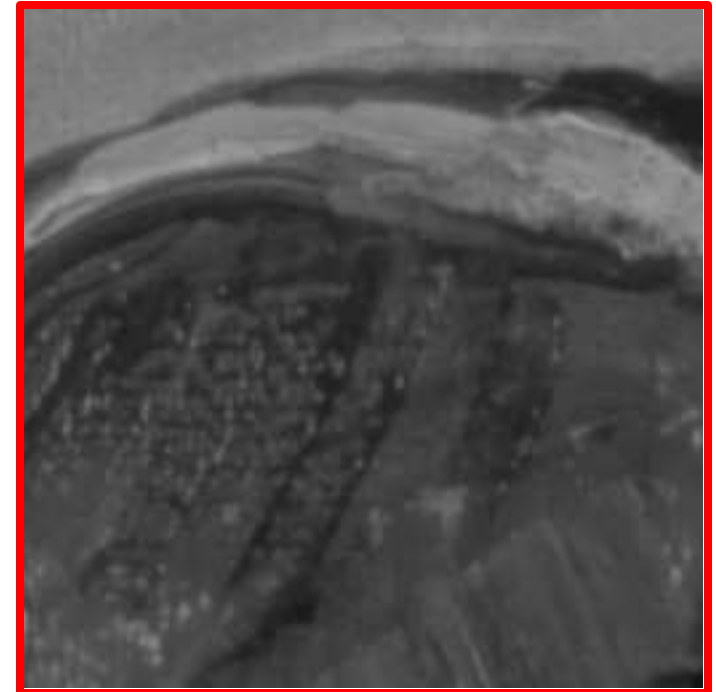
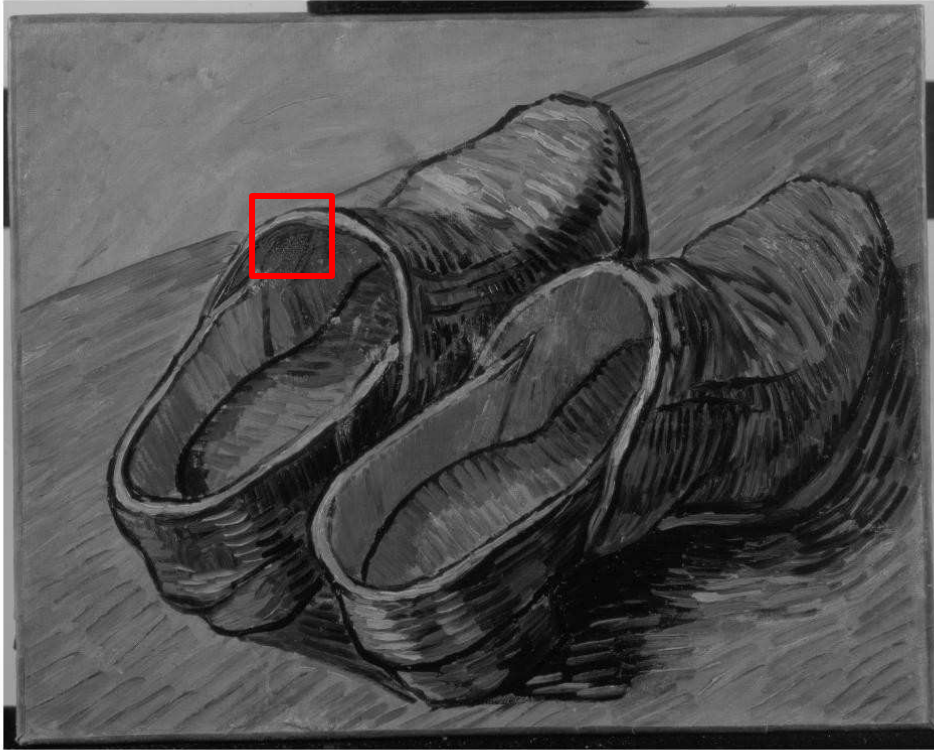
Difference = A - B

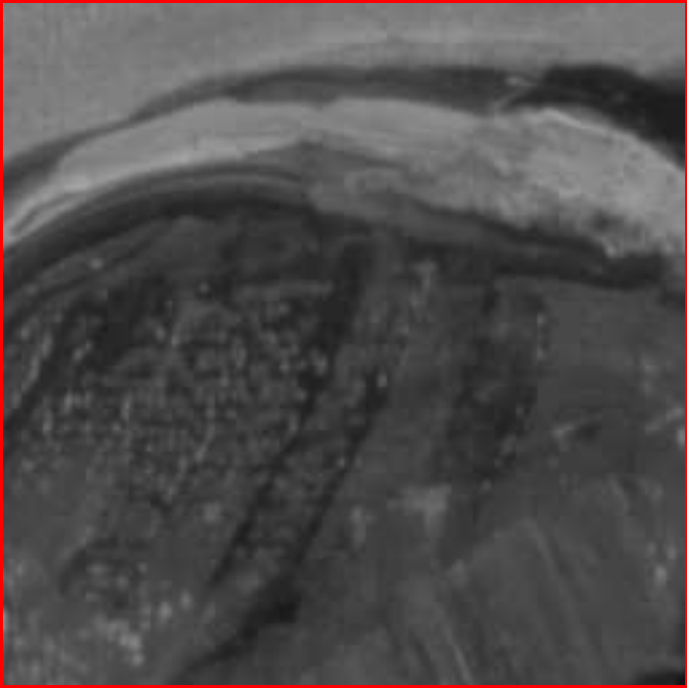
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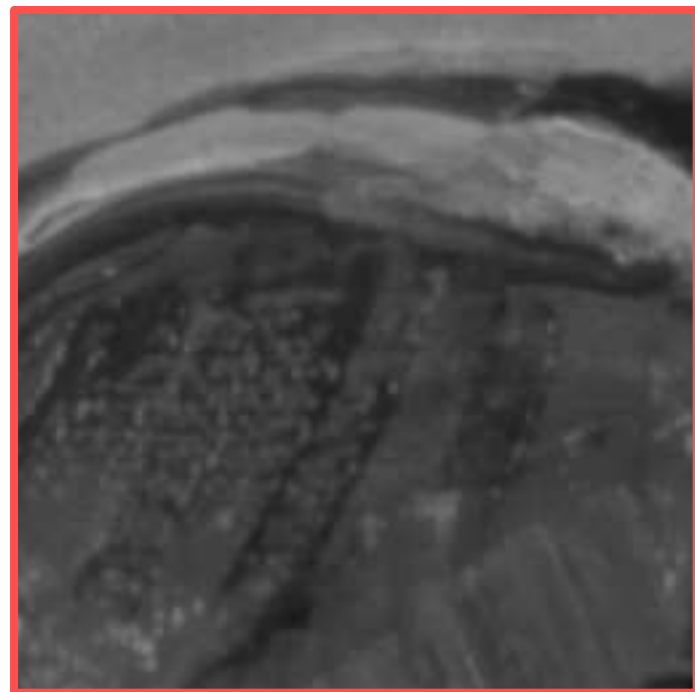
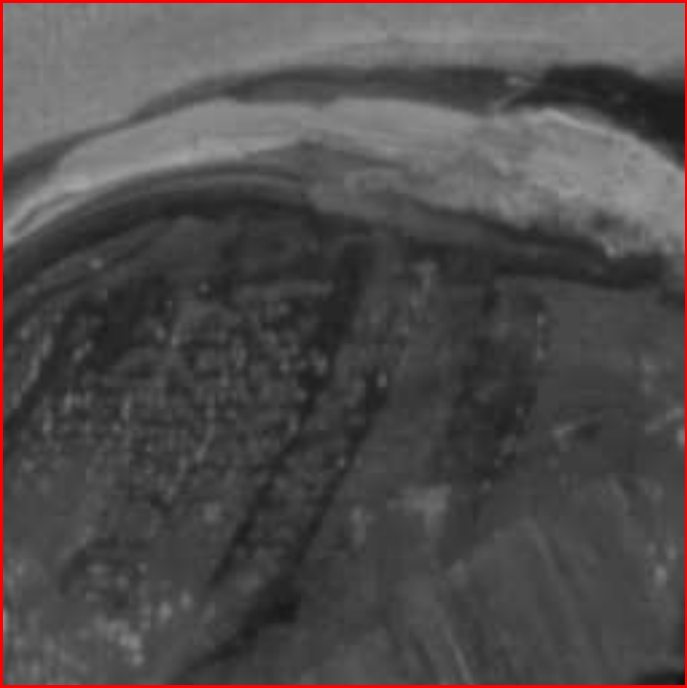
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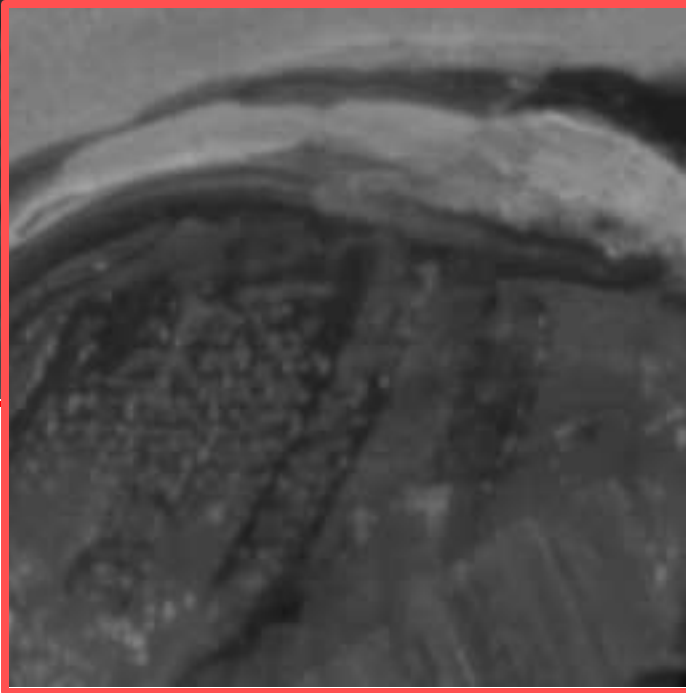
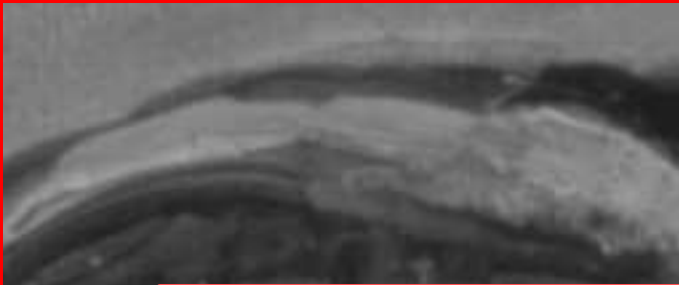
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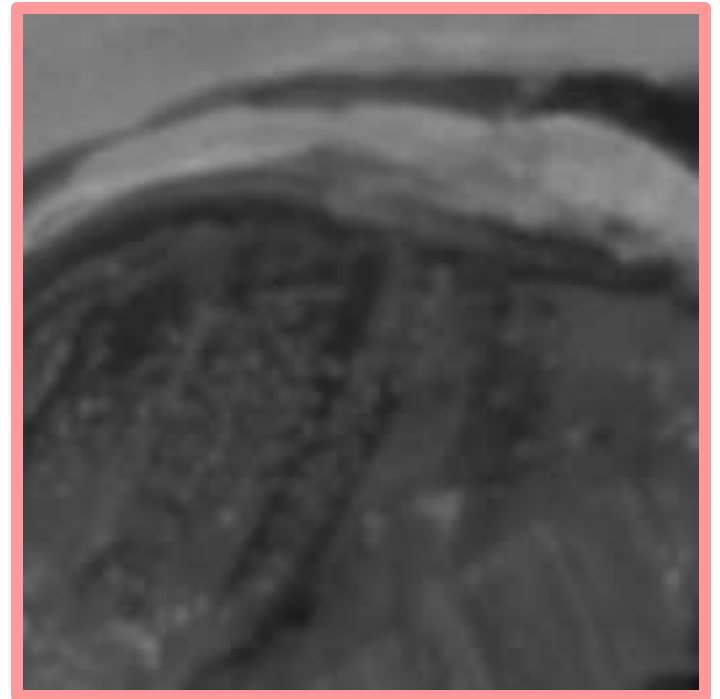
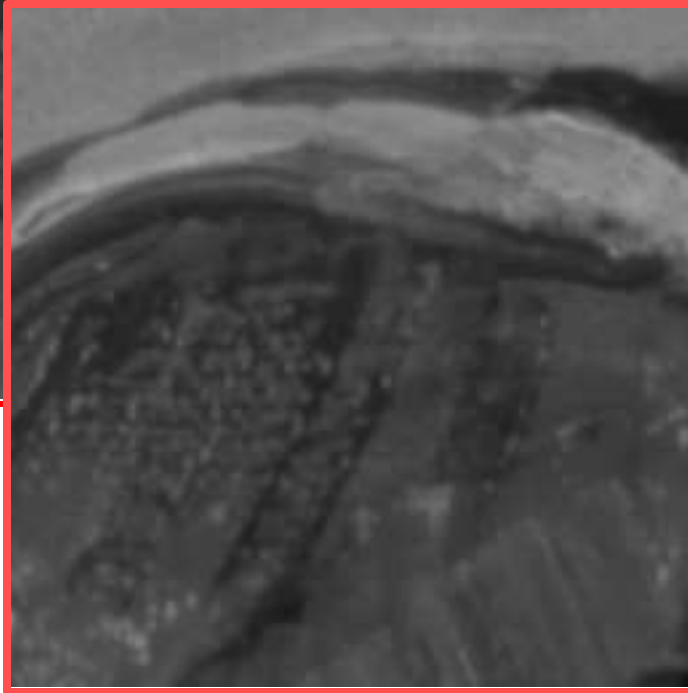
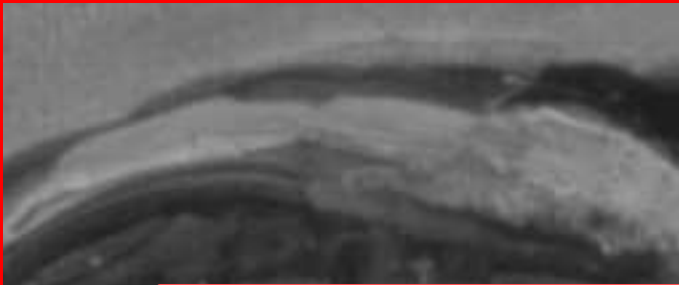


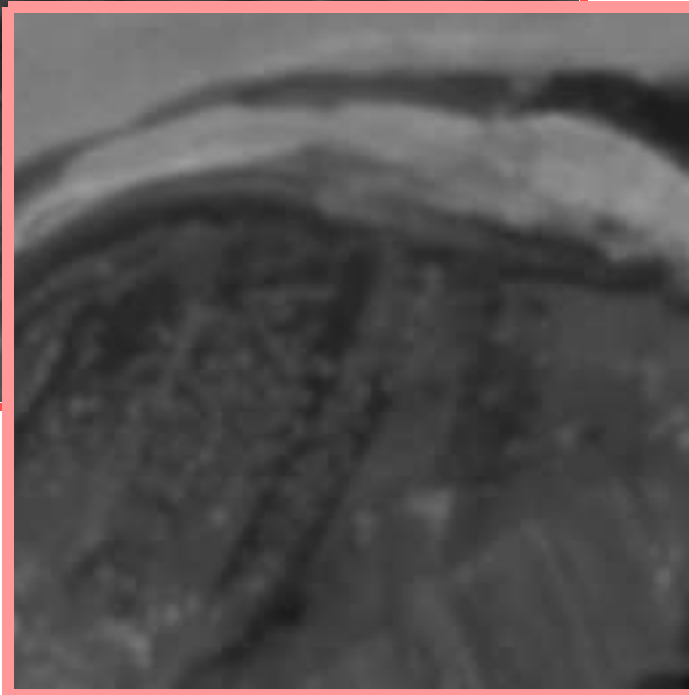
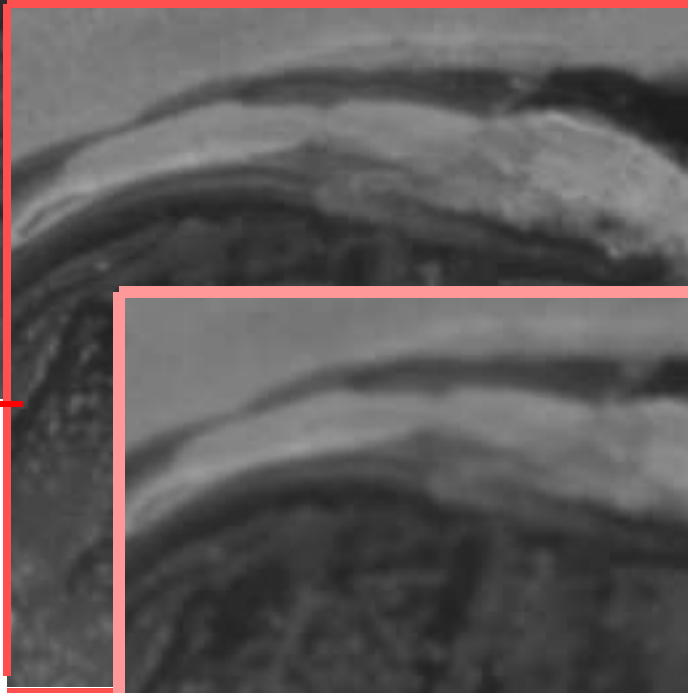
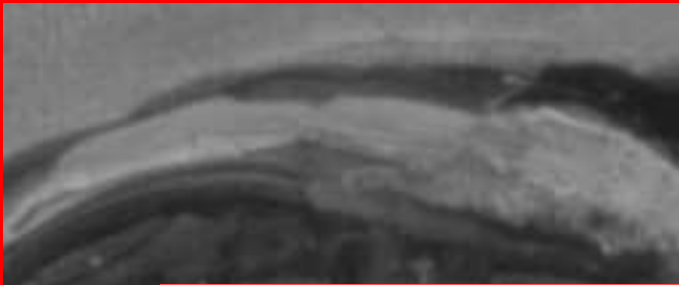




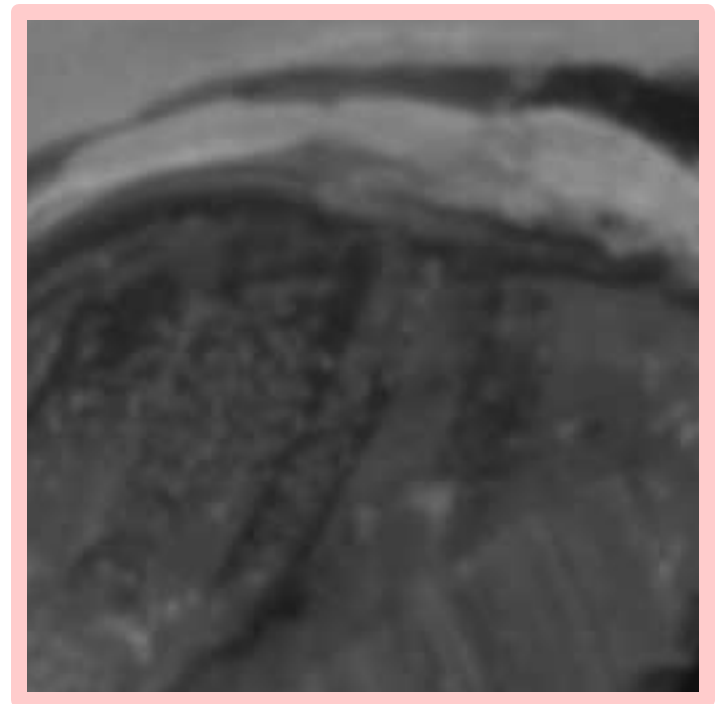
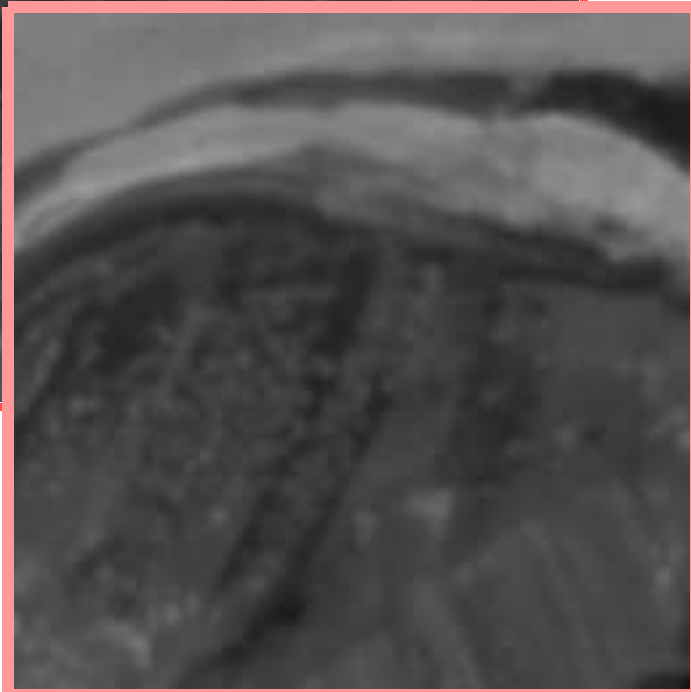
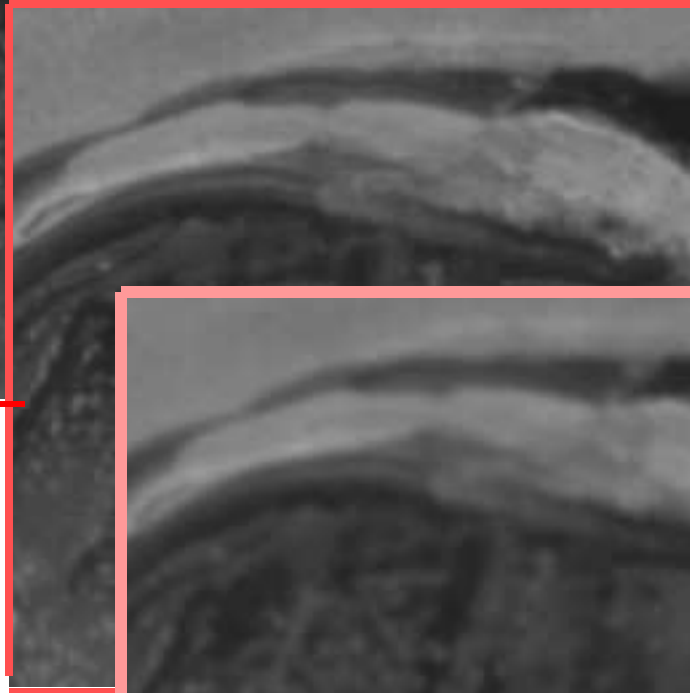
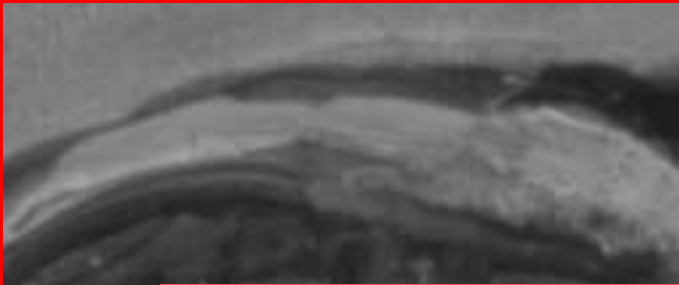


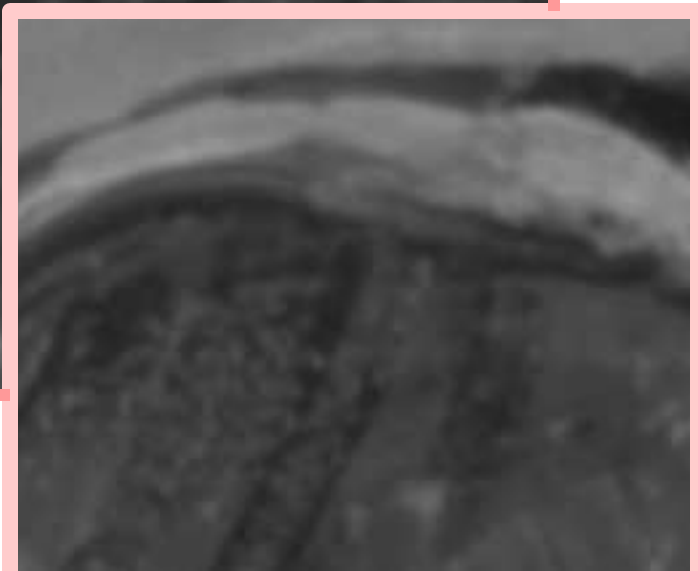
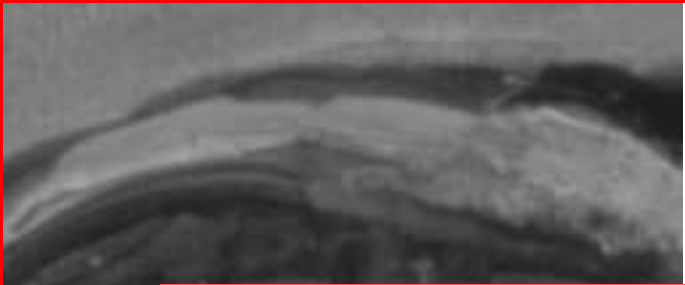


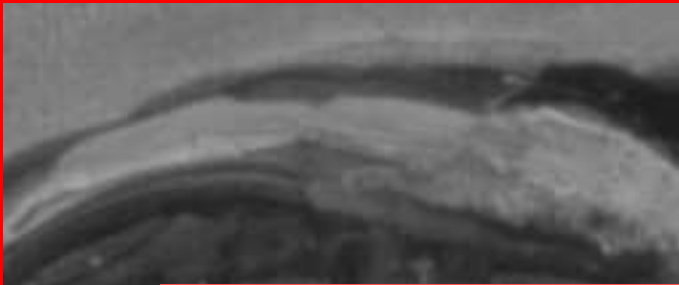






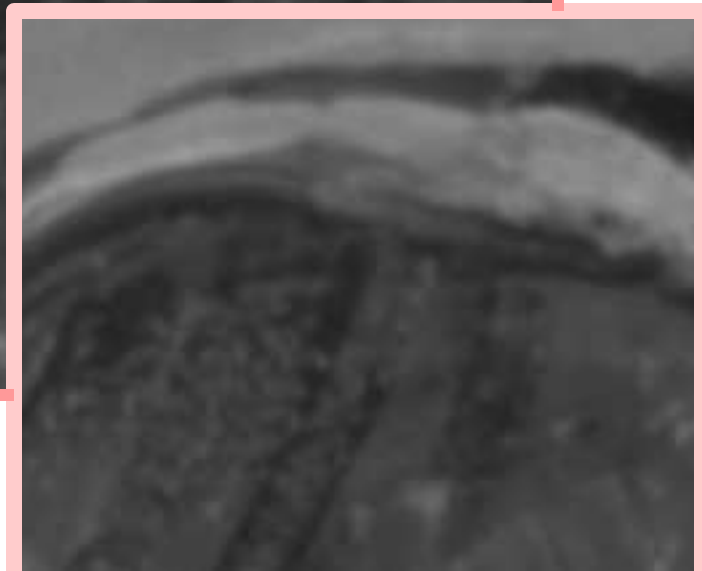


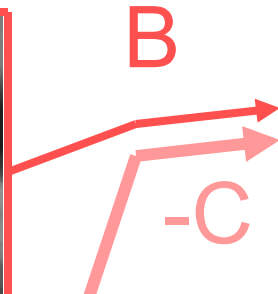
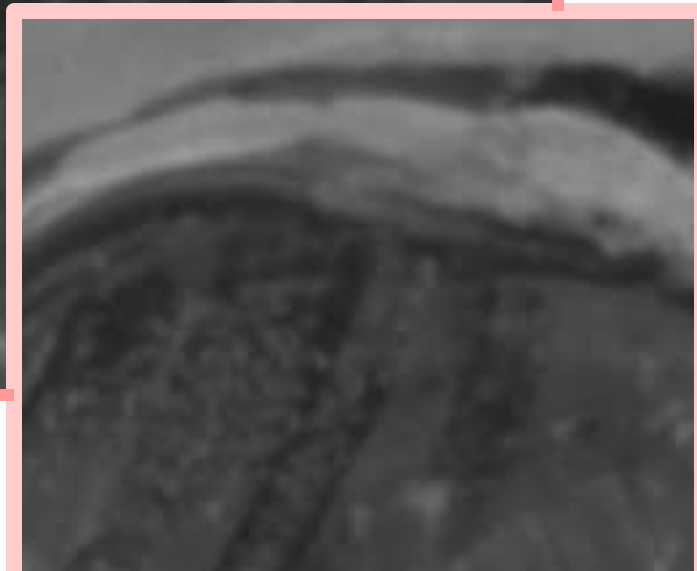
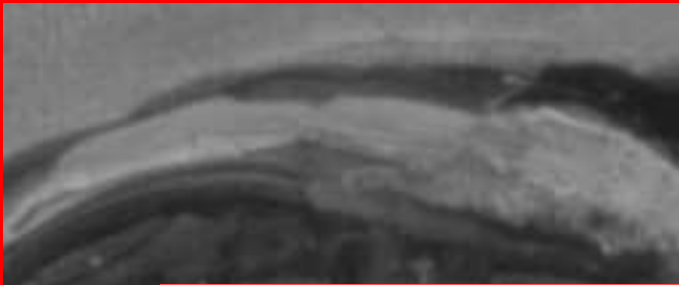




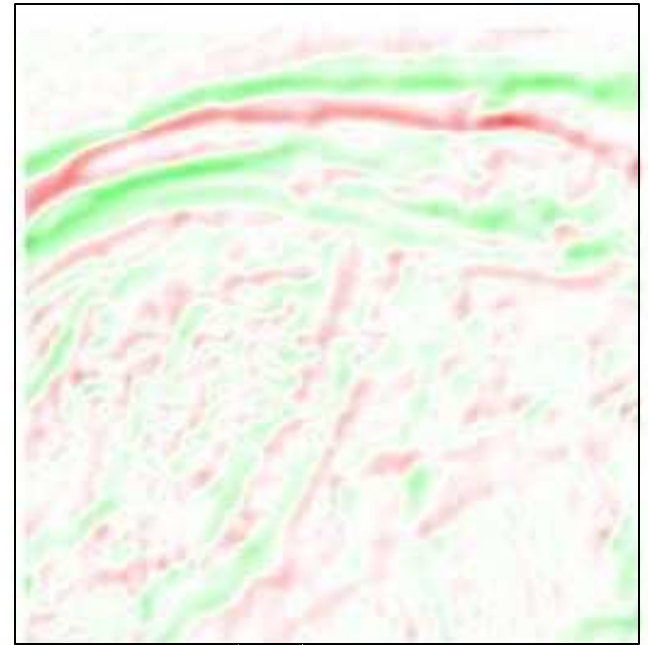
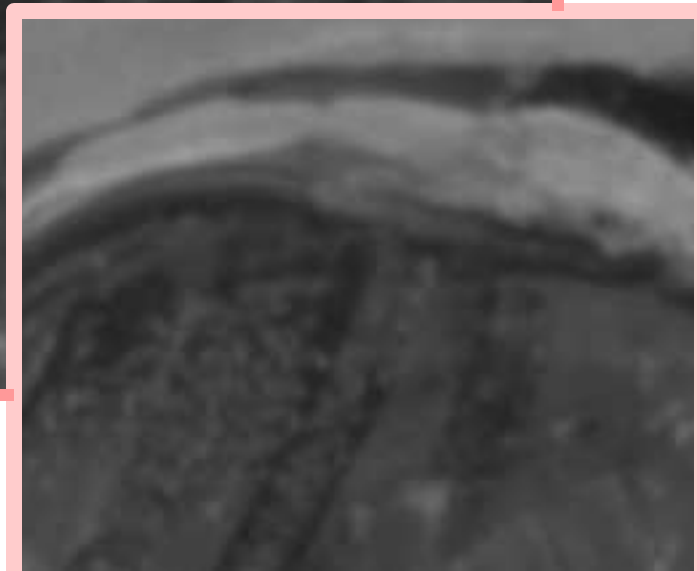
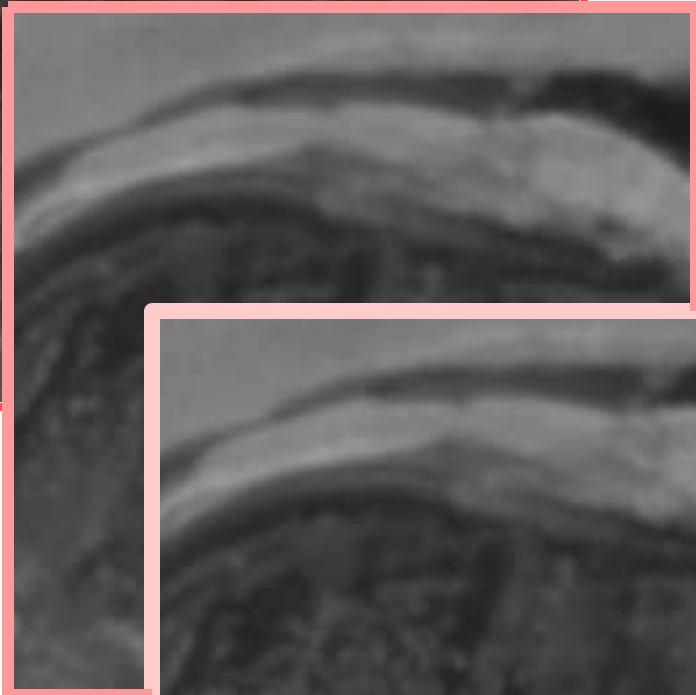
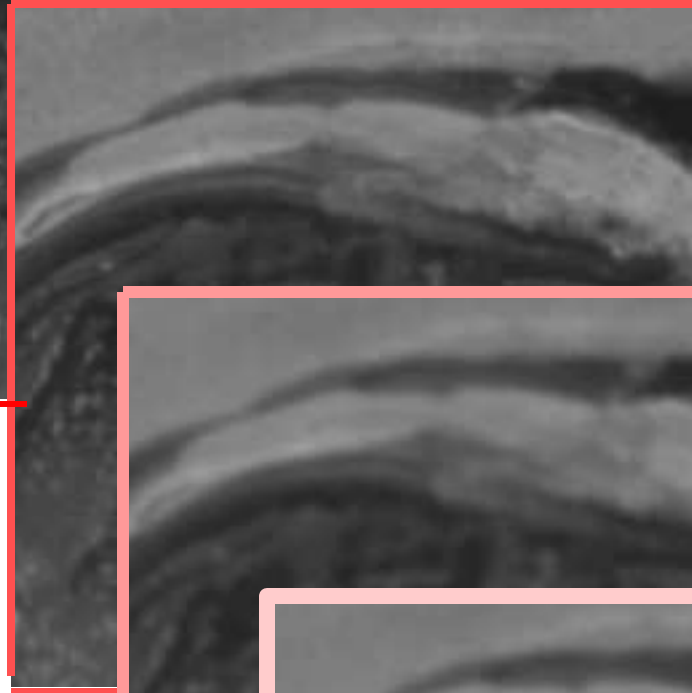
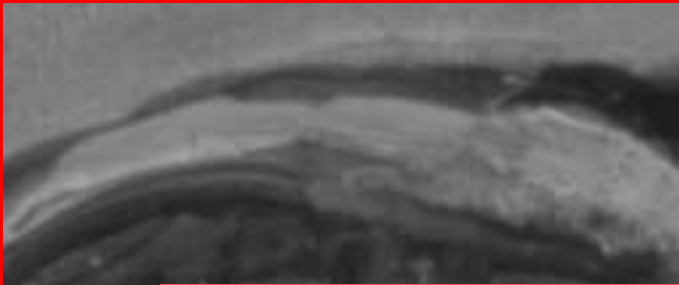
A

-B

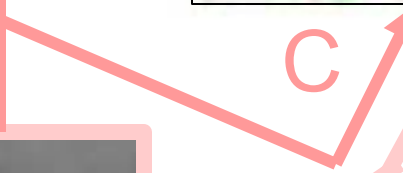


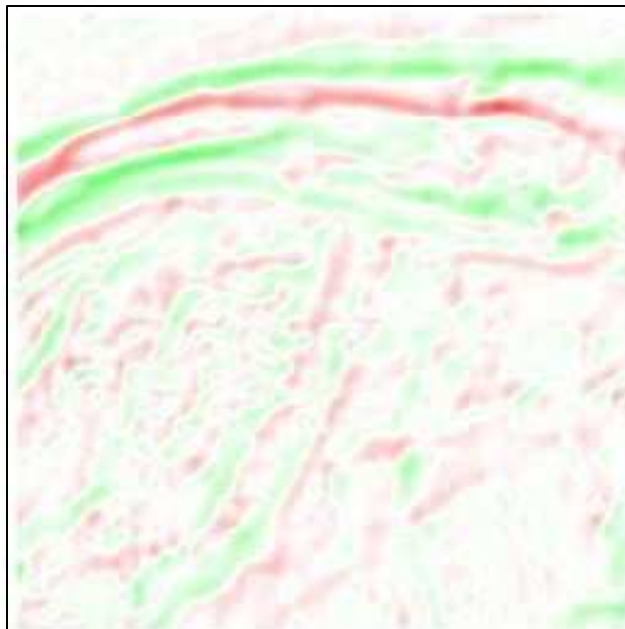


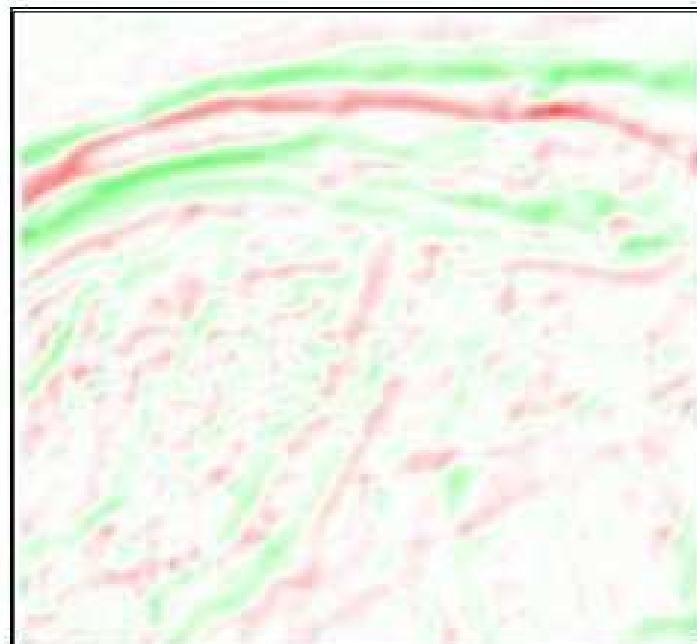
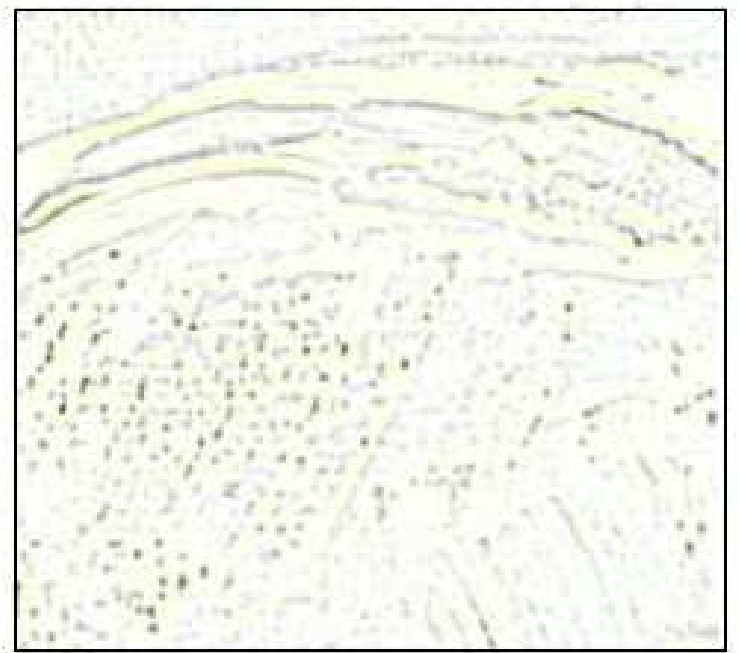


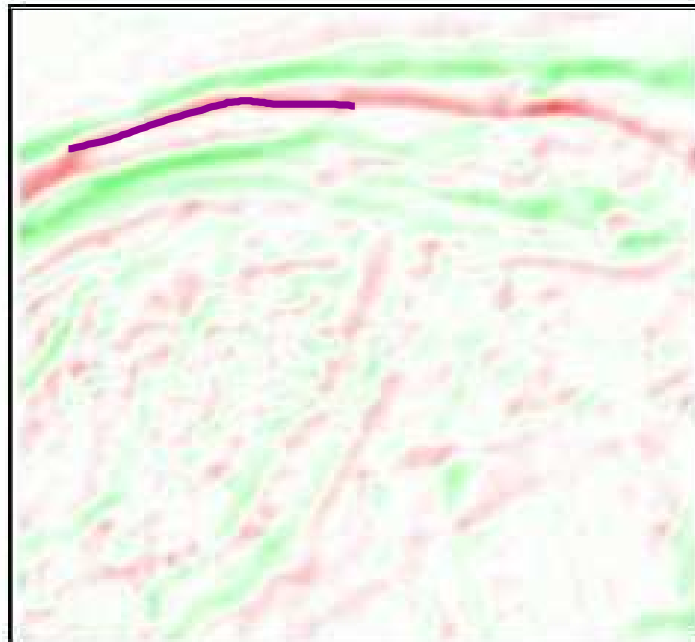
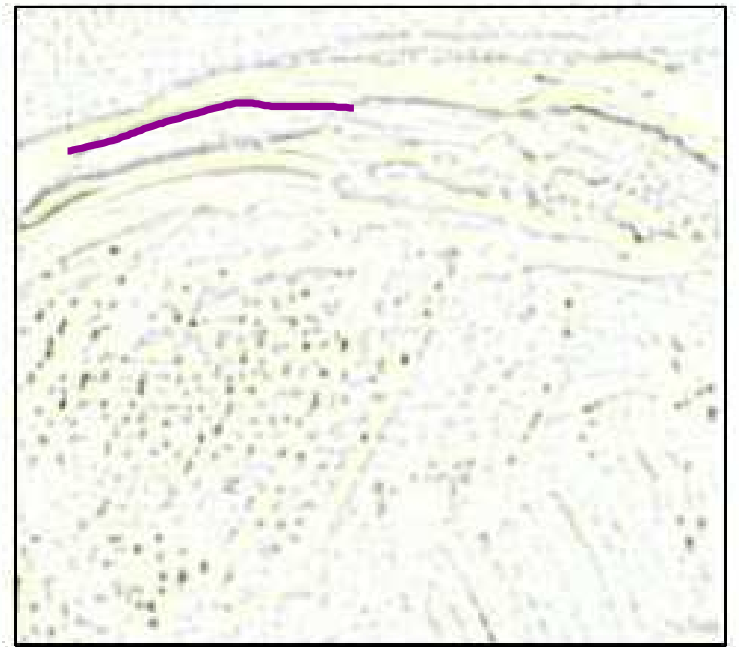


C -D

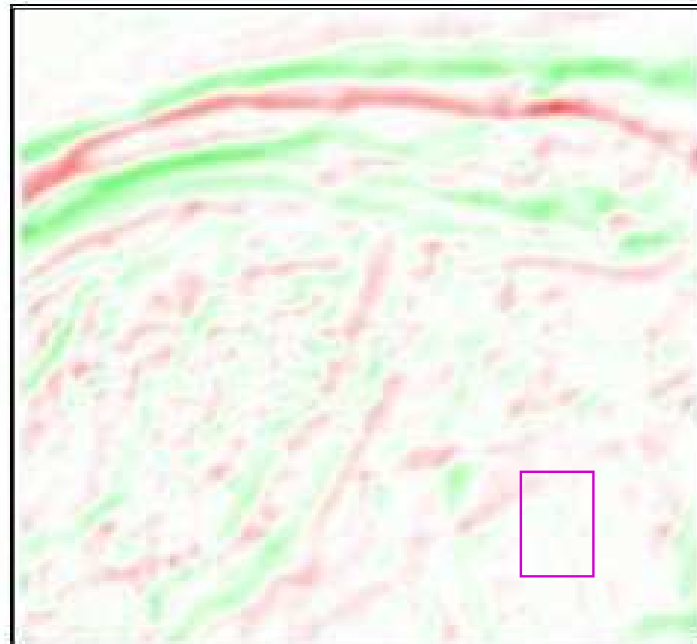
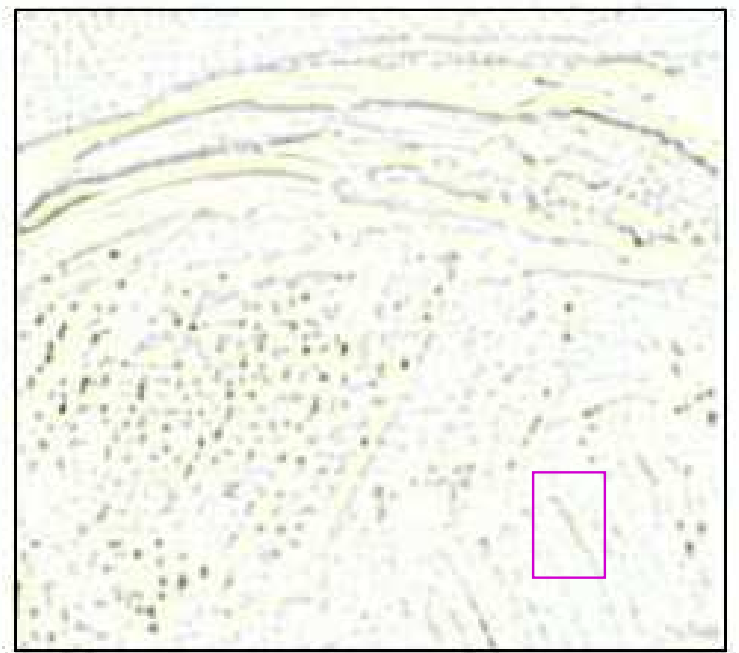


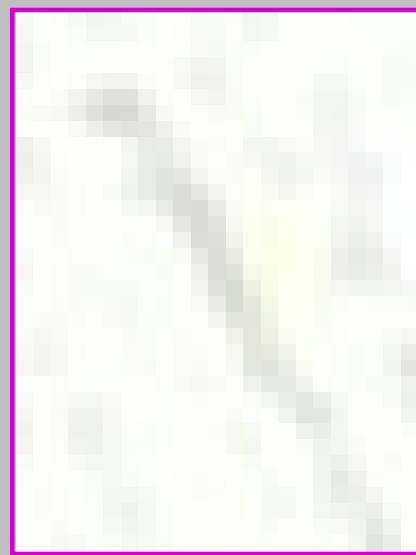
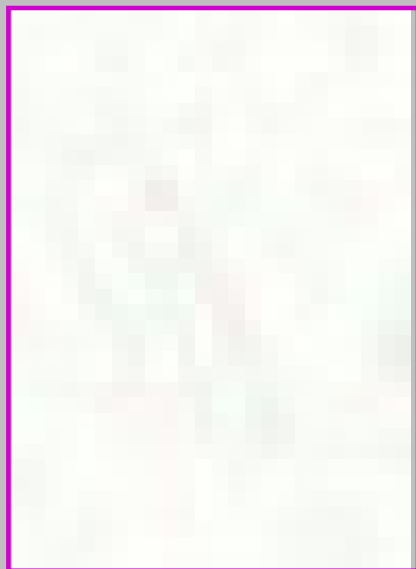












# Stylistic Analysis

- Tried to characterize Van Gogh vs. others



this separated other artists from Van Gogh.

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(show movie VG\_swirling\_2.avi if possible)

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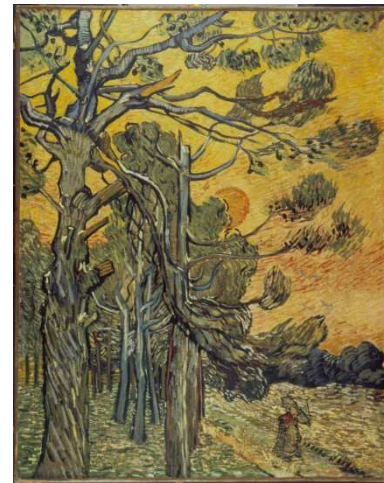


this **failed** on paintings that imitated VG's style



# From Last Year

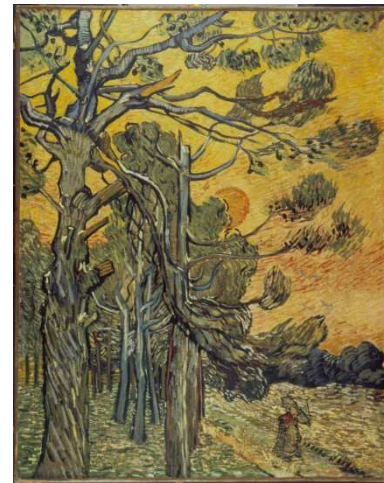
- Eric Postma's earlier work:
  - “copies have more wavelets in their decomposition”





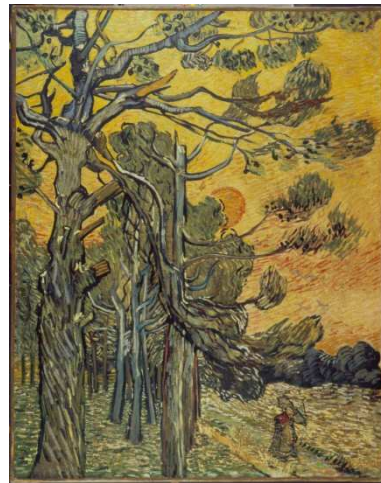
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- More wavelets means more high scale wavelets



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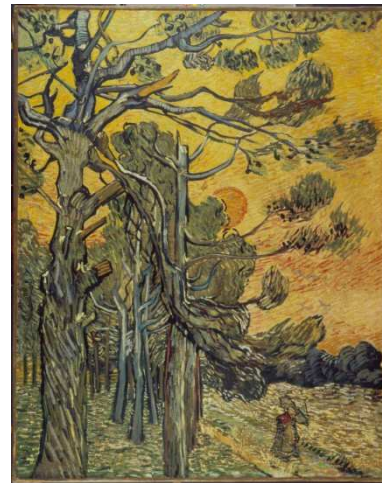
- Eric Postma's earlier work:
  - “copies have more wavelets in their decomposition”
- More wavelets means more high scale wavelets
- Check for finest scales!





# From Last Year

- In paintings that are copies (regardless of who does the copying) or that are more “hesitating”, there is a much larger concentration in the finest scales



# The NOVA Challenge

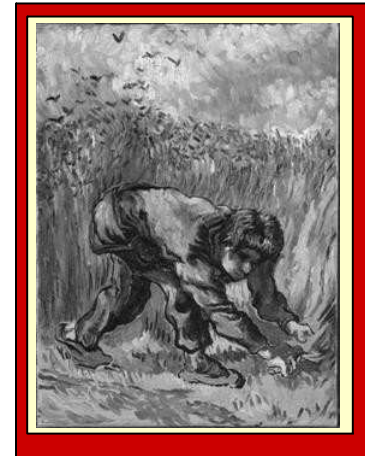
- This allowed us to distinguish a copy by Charlotte Caspers from 5 original Van Goghs.



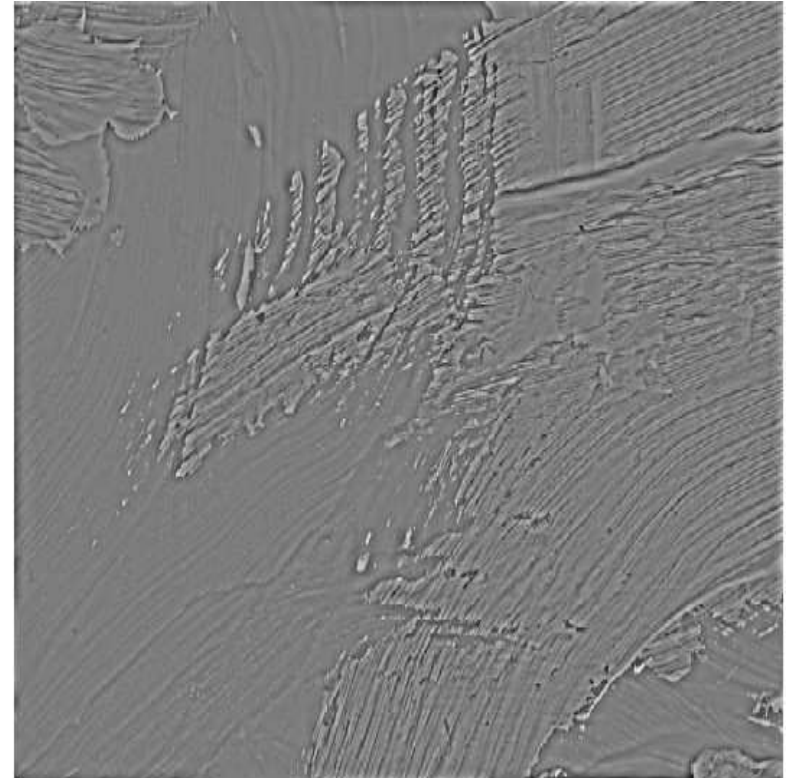


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# What is Fine Scale Detail?





# Work on Expanded Dataset

- Measured fine scale detail on this year's expanded dataset.

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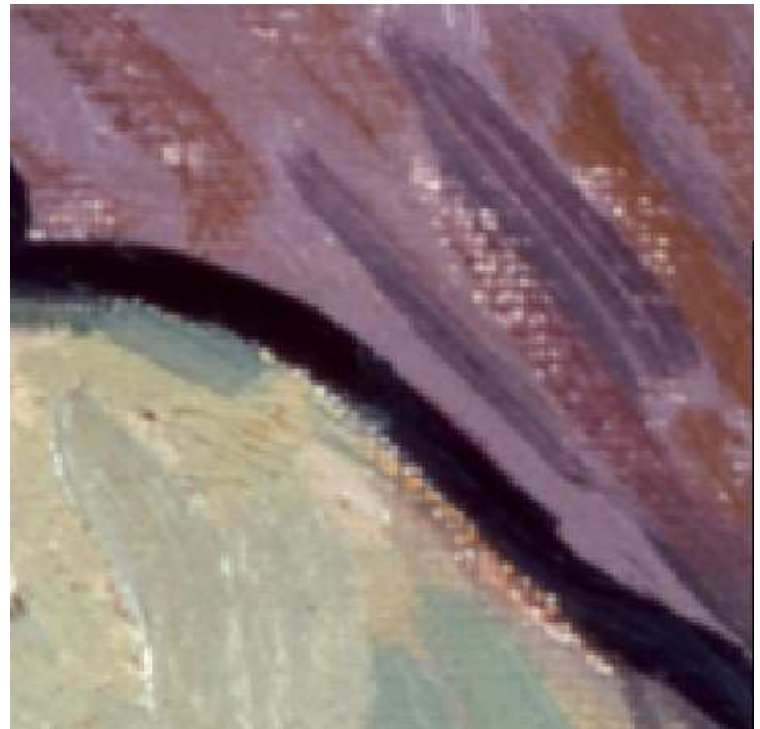
WHY?

# Sharpness

- Eric Postma recently purchased a new slide scanner, on which the new images were scanned.
- New images are crisper than our old ones.



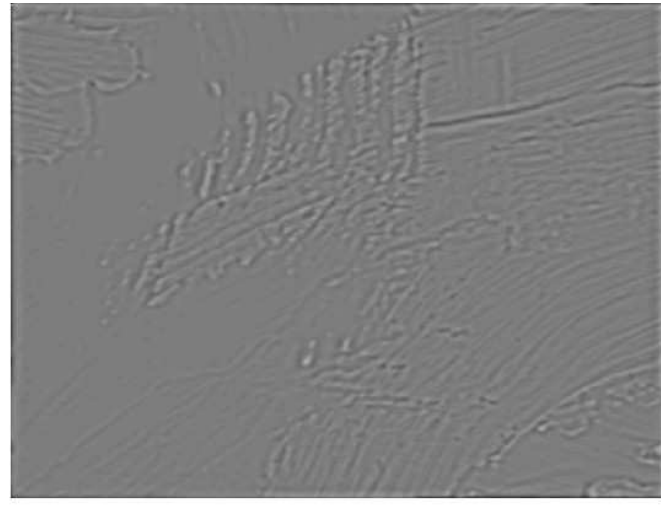
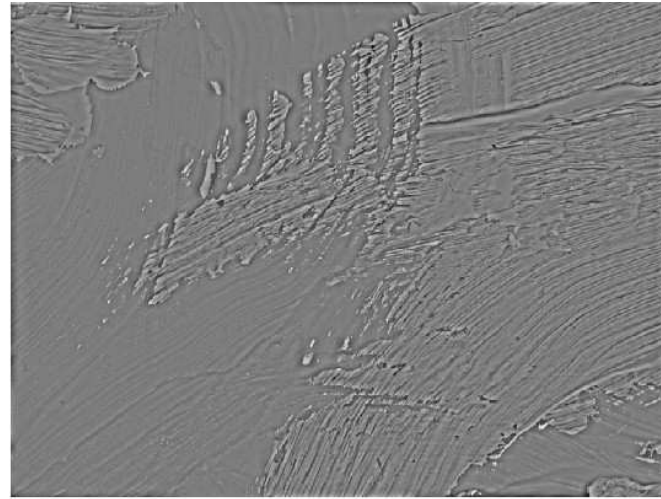
Section of Previously Scanned  
E338



Section of Newly Scanned  
E506



# Effect of Blur on Fine Scale Detail



Blurry pictures have less fine scale detail.

# Measuring Blur

- Measured blur **quantitatively** in previous sets of paintings examined. For the NOVA 6:



0.65



0.98



0.9



0.10



0.93



0.90

The copy is by far the least blurry. This unfairly helped us detect it ...

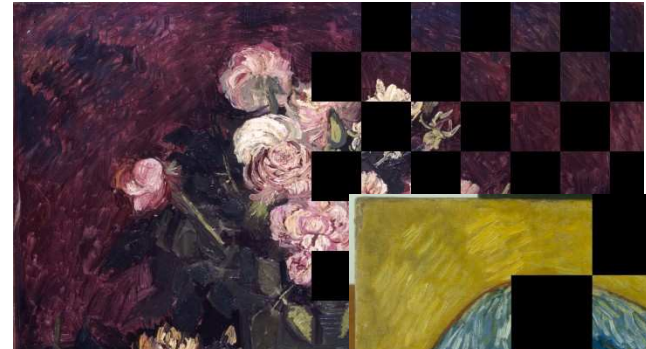


# A Fairer Test

Copies

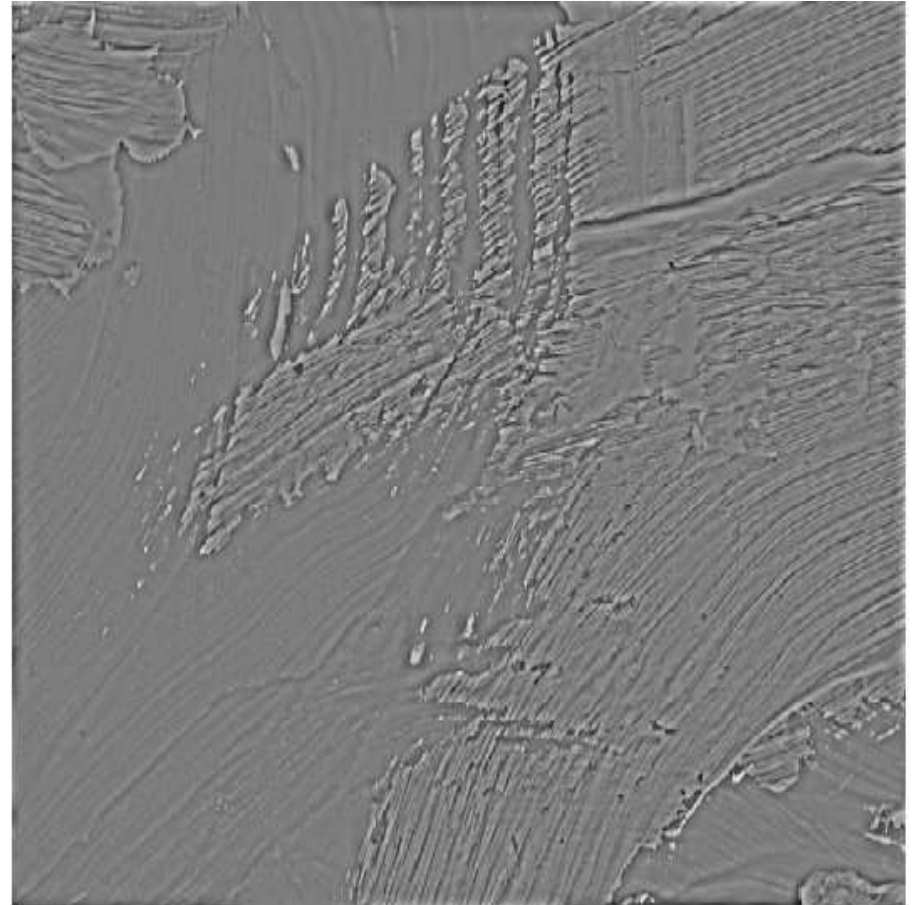
Vs.

Originals of Similar Blur



# Methods to Overcome Blur

What are we trying to characterize by measuring fine scale detail amount?





# Methods to Overcome Blur

- Idea: Classify different TYPES of fine scale details:
- compositional edges that will always be present
- wobbles

# Results of Two Approaches

- Measure only weight of very finest scales:

- Correct 87% of the time on test set.

Does not generalize well to other copies: Does not do well on S506.

- Use more sophisticated wavelet features:

- Correct 90% of the time on test set.

Generalizes well to other copies:  
Classifies 87% of S506 correctly.

# A Second Validation Test

- We asked Charlotte Caspers to paint a series of pairs of small paintings
- In each pair: one original  
one copy
- Different pairs painted with different brushes, paint, background, ...



# A Second Validation Test



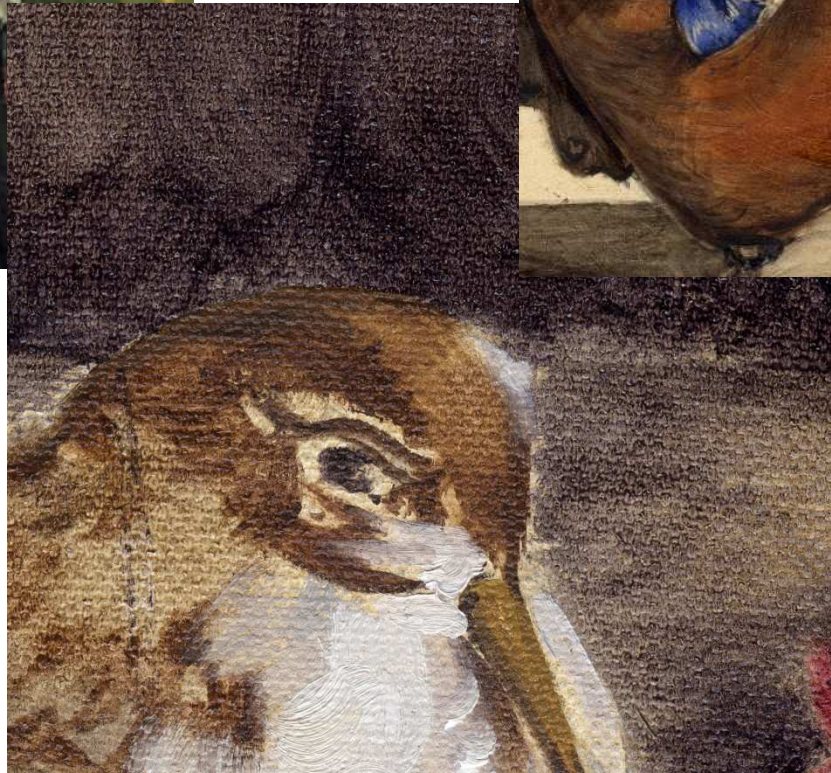




Some of the originals and copies painted by Charlotte.



# Variety of Materials and Styles



# Advantages of this Dataset

- Ground truth: we **know** which are “hesitating” copies and which are originals
- Uniform digital imaging conditions
  - Blur, lighting, etc. are same
  - High-quality direct digital scan of surface
- Variety of materials and styles



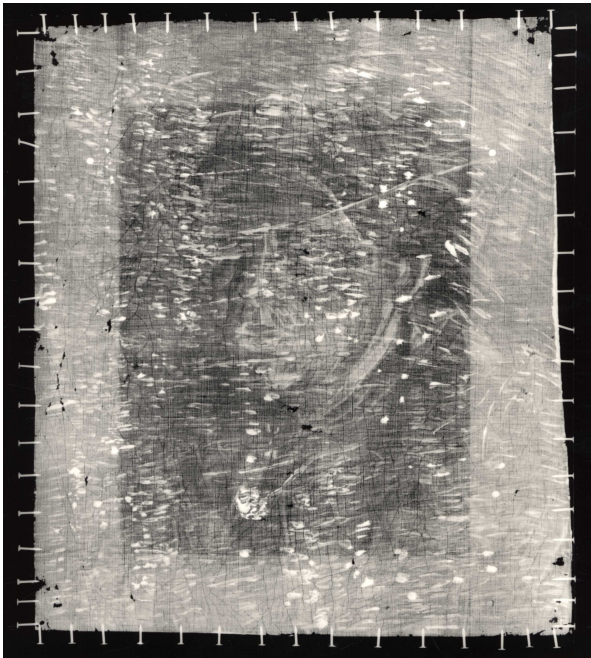
# Methods of Testing



- Known materials test:
  - Cross-validation on all patches of all materials
  - Simulates having seen an original and a copy in these materials before.
- Unknown materials test:
  - Only learn from other paintings (other materials).



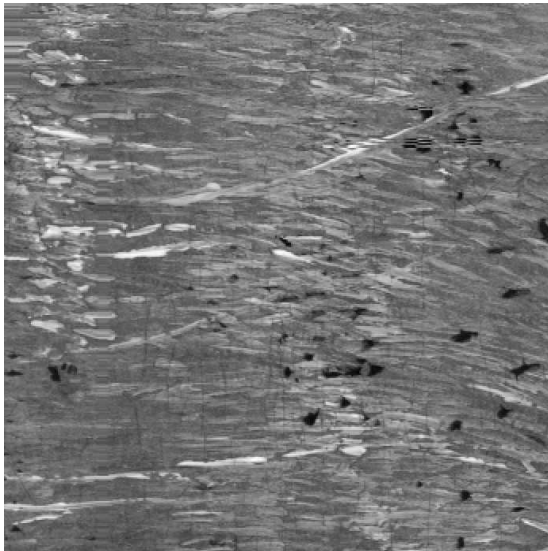


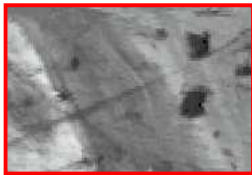
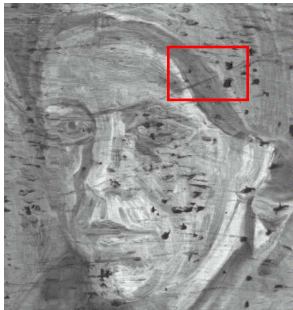


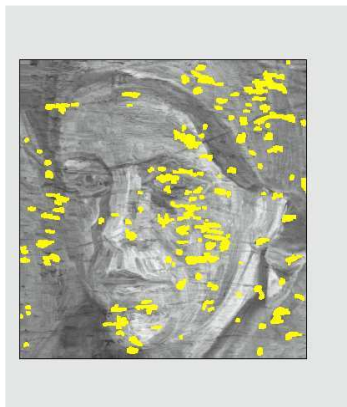


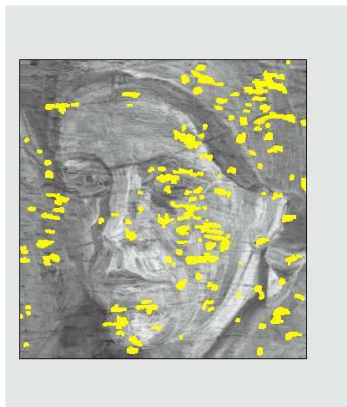






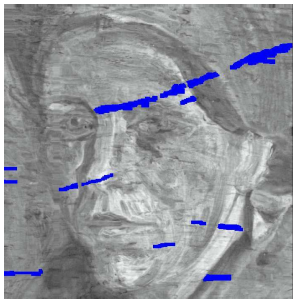


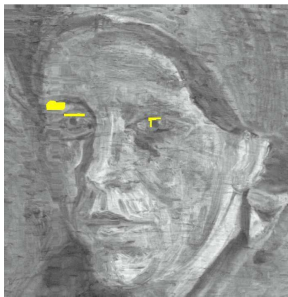


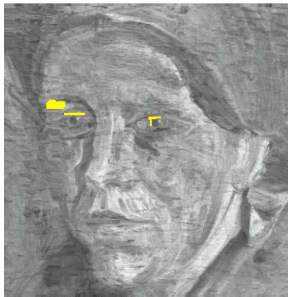














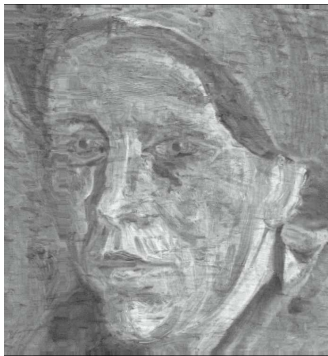












**Sb**



**Hg**







