SUNY COLLEGE OF OPTOMETRY
GRADUATE CENTER
FOR VISION RESEARCH

SUNY

INFERENCES OF MATERIAL PROPERTIES BASED ON FREQUENCY-BAND ANALYSES

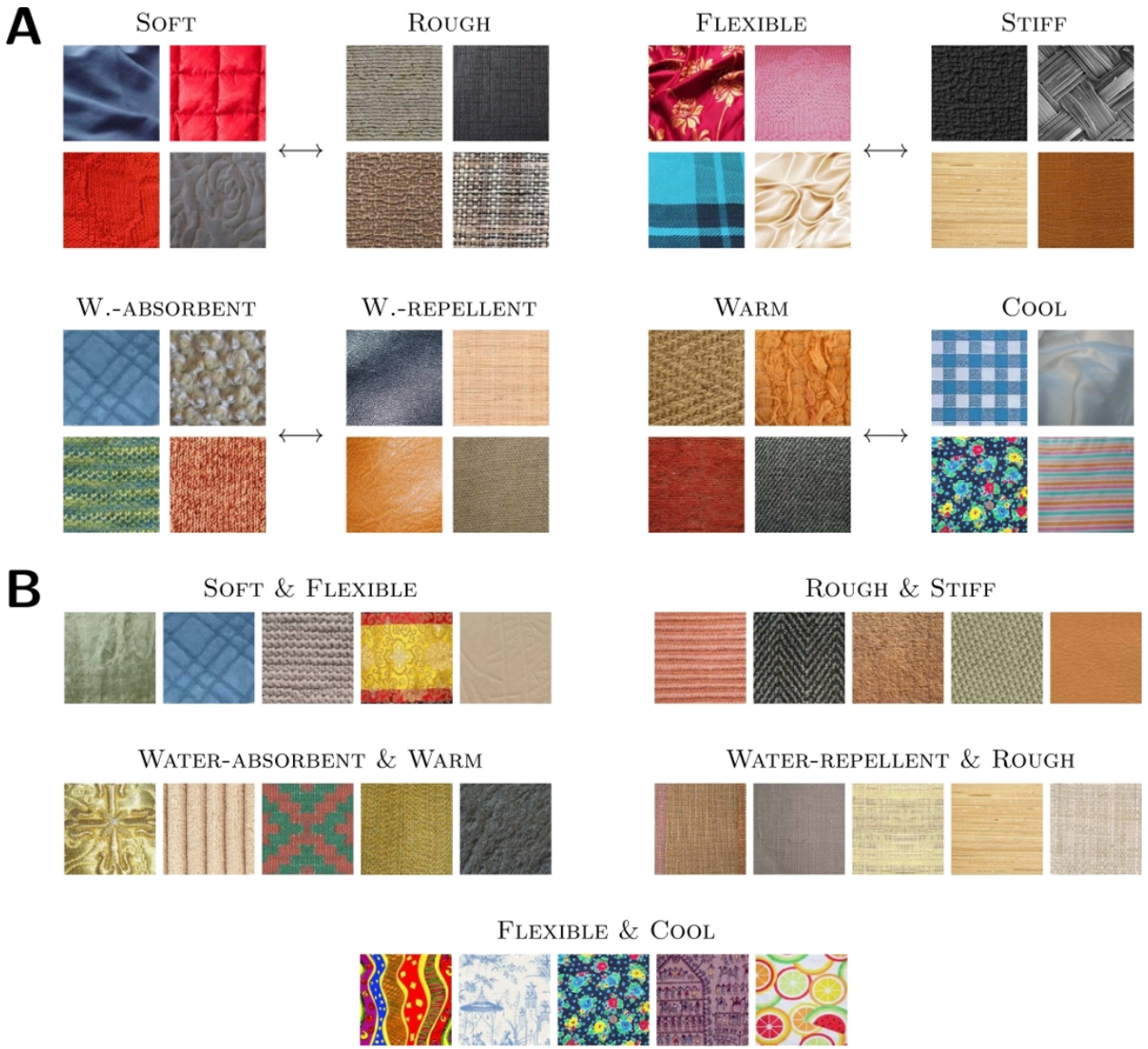
QASIM ZAIDI & MARTIN GIESEL

SUNY College of Optometry
New York

ECVP 2012

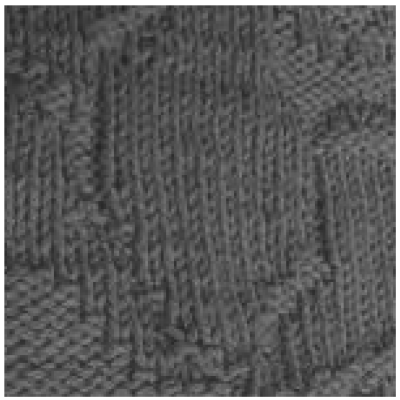
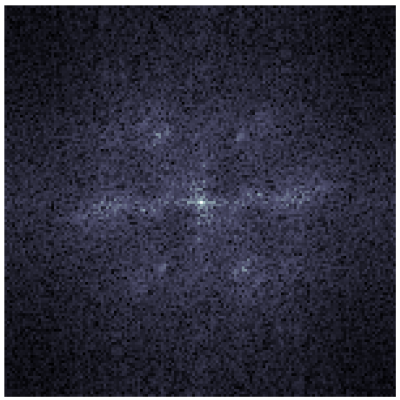
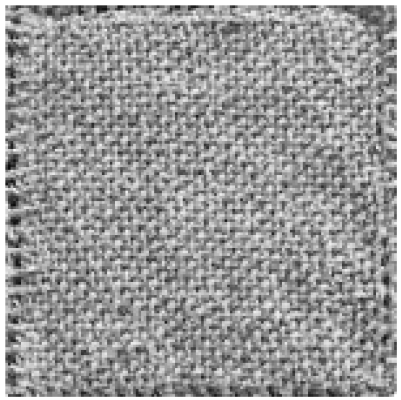
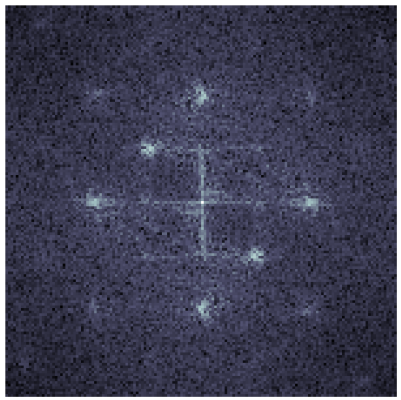
Properties of fabrics

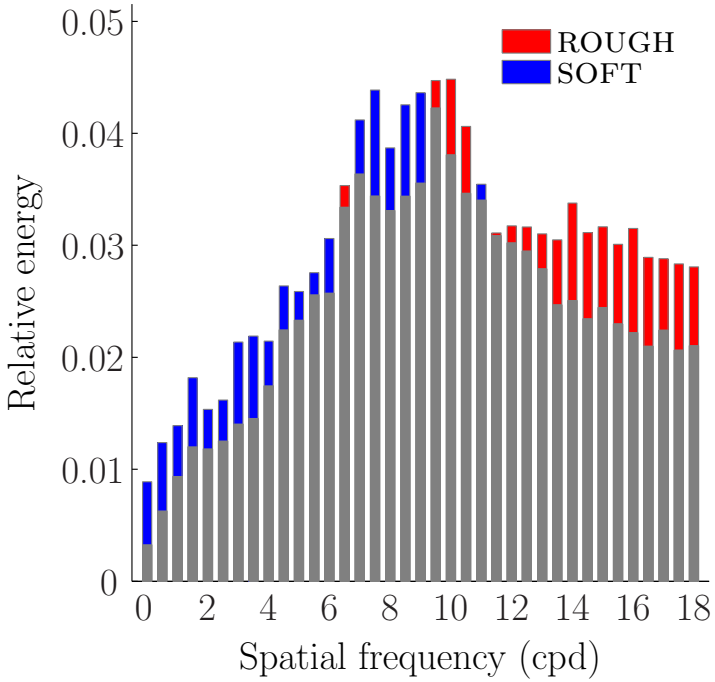
Results of the rating experiment



Soft vs. rough

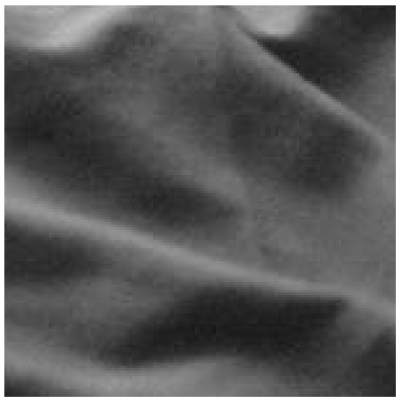
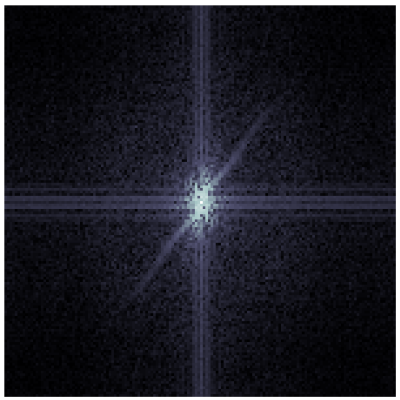
6.5 – 15.2 cpd

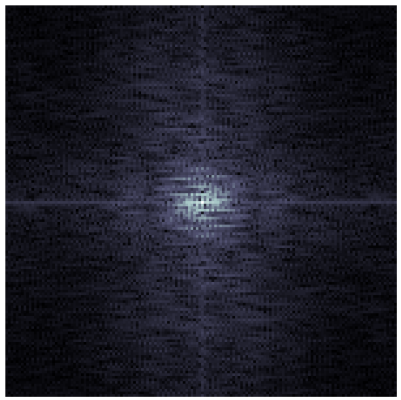





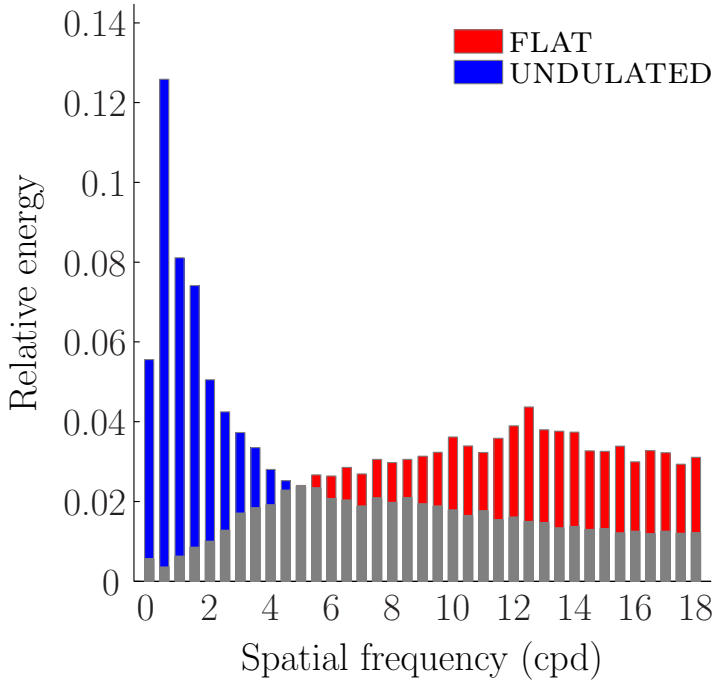


Undulated vs. flat

0.5 – 2.3 cpd

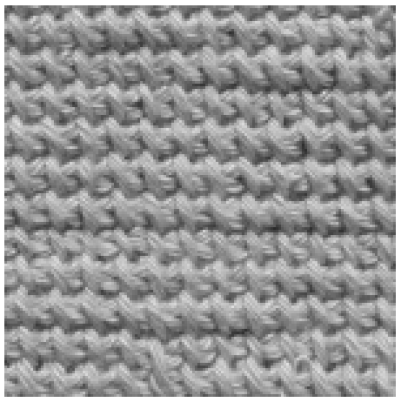
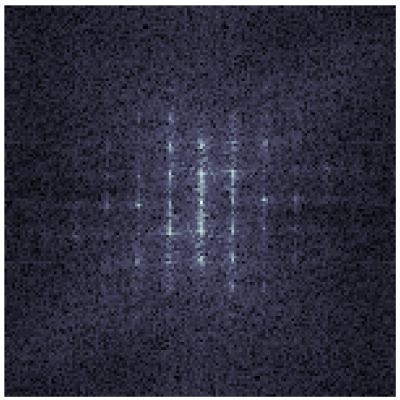
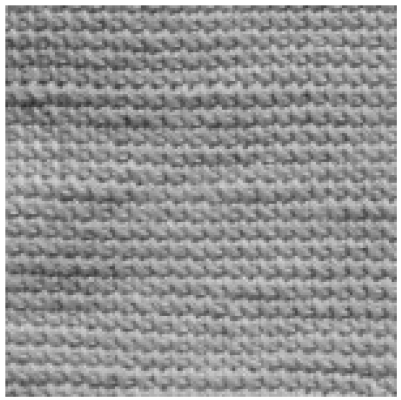
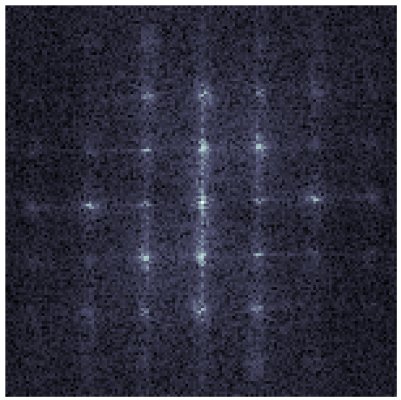



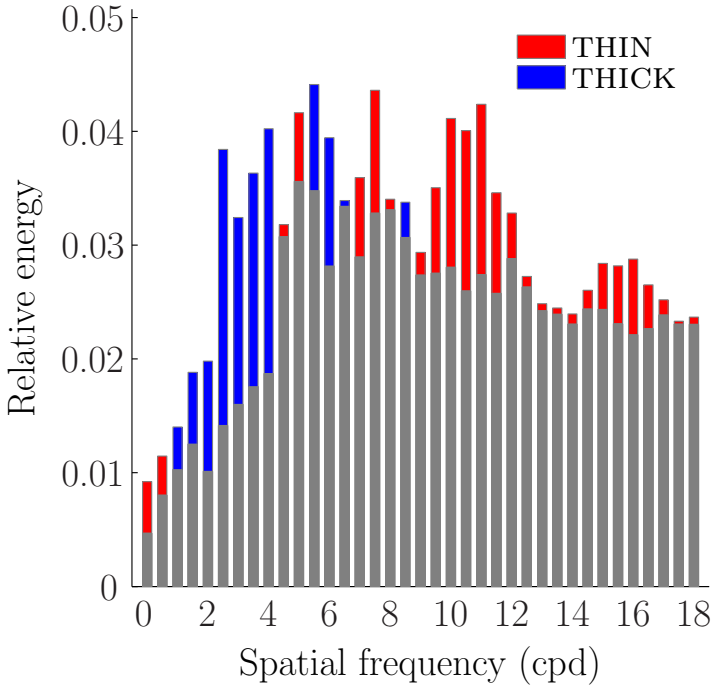




Thin vs. Thick

2.3 – 4.3 cpd



Frequency band manipulations

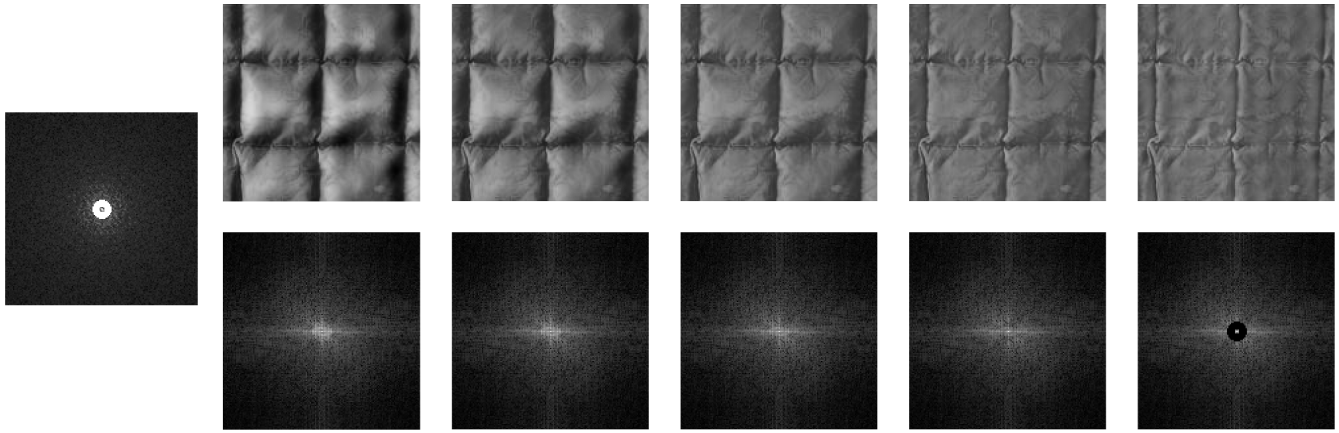
- Spatial frequency bands
  - 0.5 – 2.3 cpd: Volume or Shape-from-shading band
  - 2.3 – 4.3 cpd: Thickness band
  - 6.5 – 15.2 cpd: Roughness band
- Multiplicative scaling of frequency band

- Constant total energy

Shape-from-shading band

0.5 – 2.3 cpd

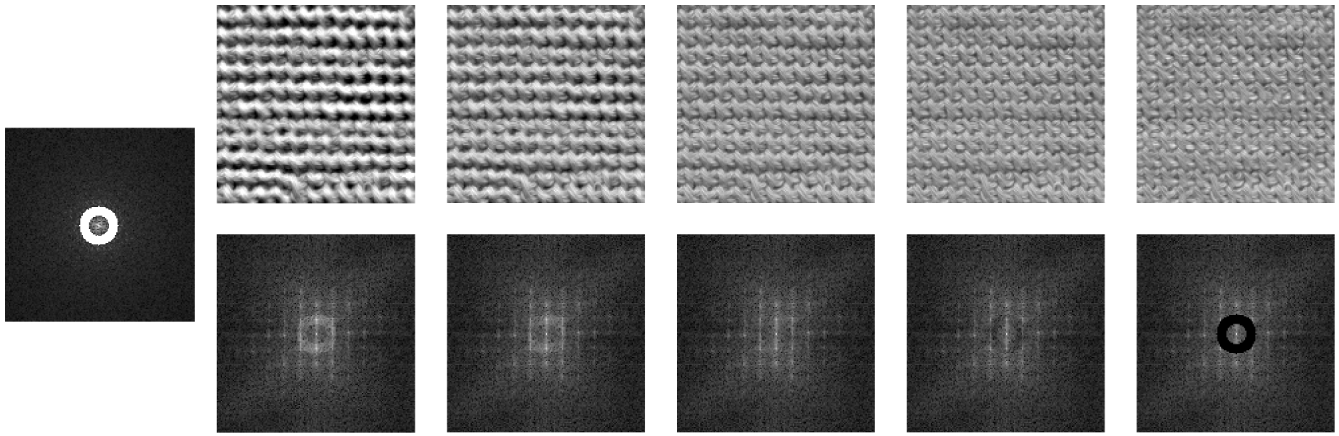
INFLATE ⟷ DEFLATE



Thickness band

2.3 – 4.3 cpd

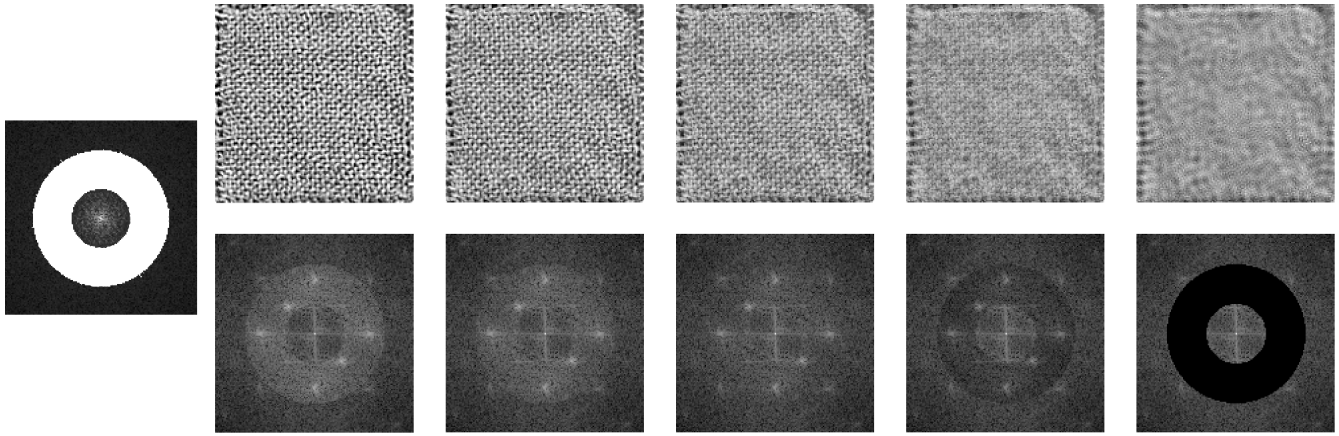
THICKER $\longleftrightarrow$ THINNER



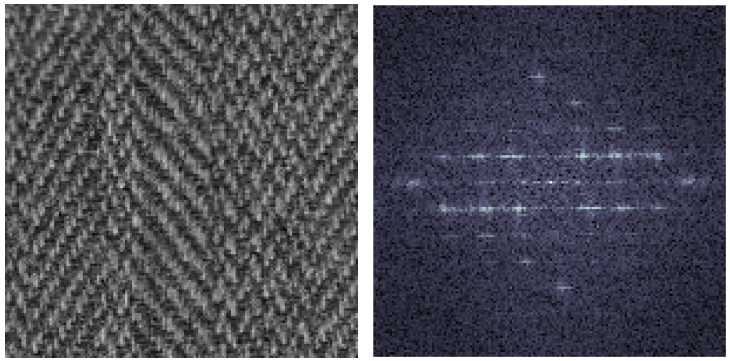
Roughness band

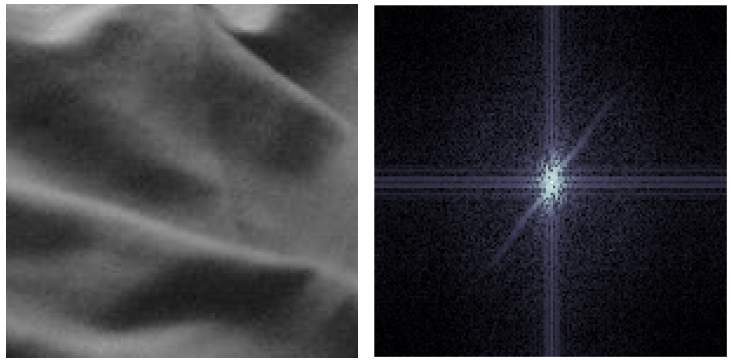
6.5 – 15.2 cpd

ROUGHER ⟷ SOFTER

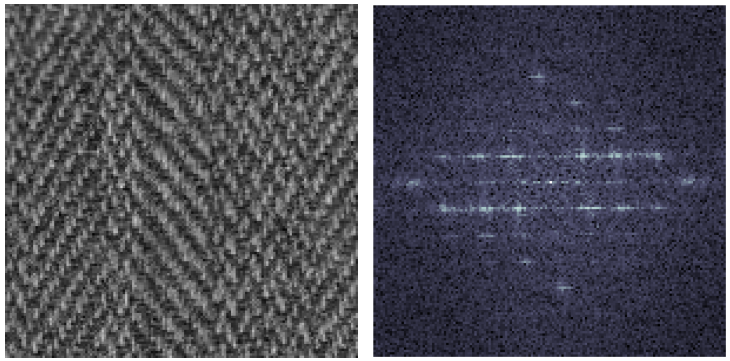


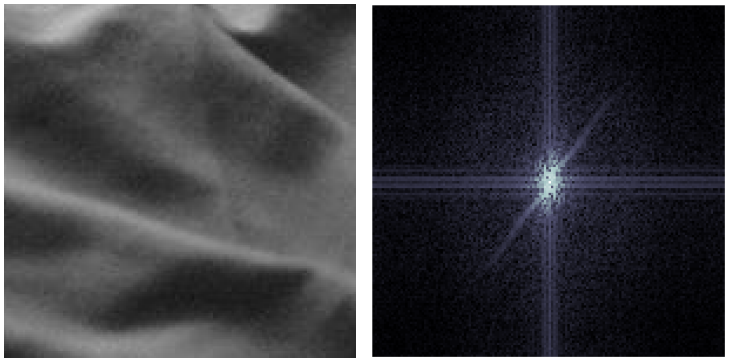
Transfer of structure

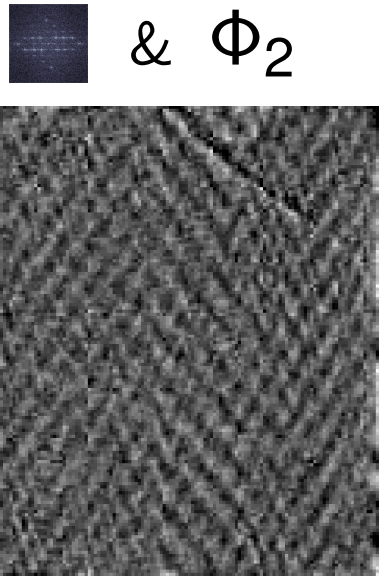




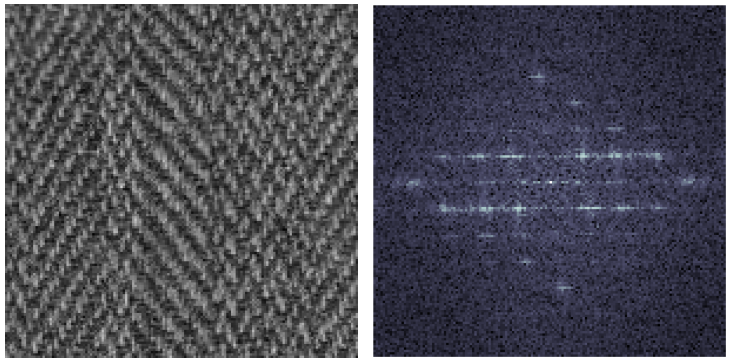
Transfer of structure

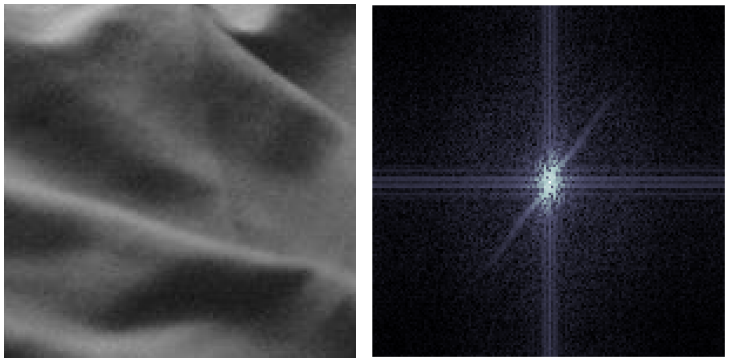


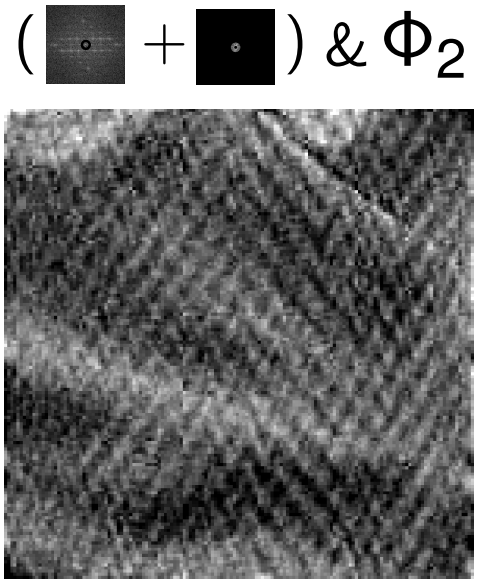




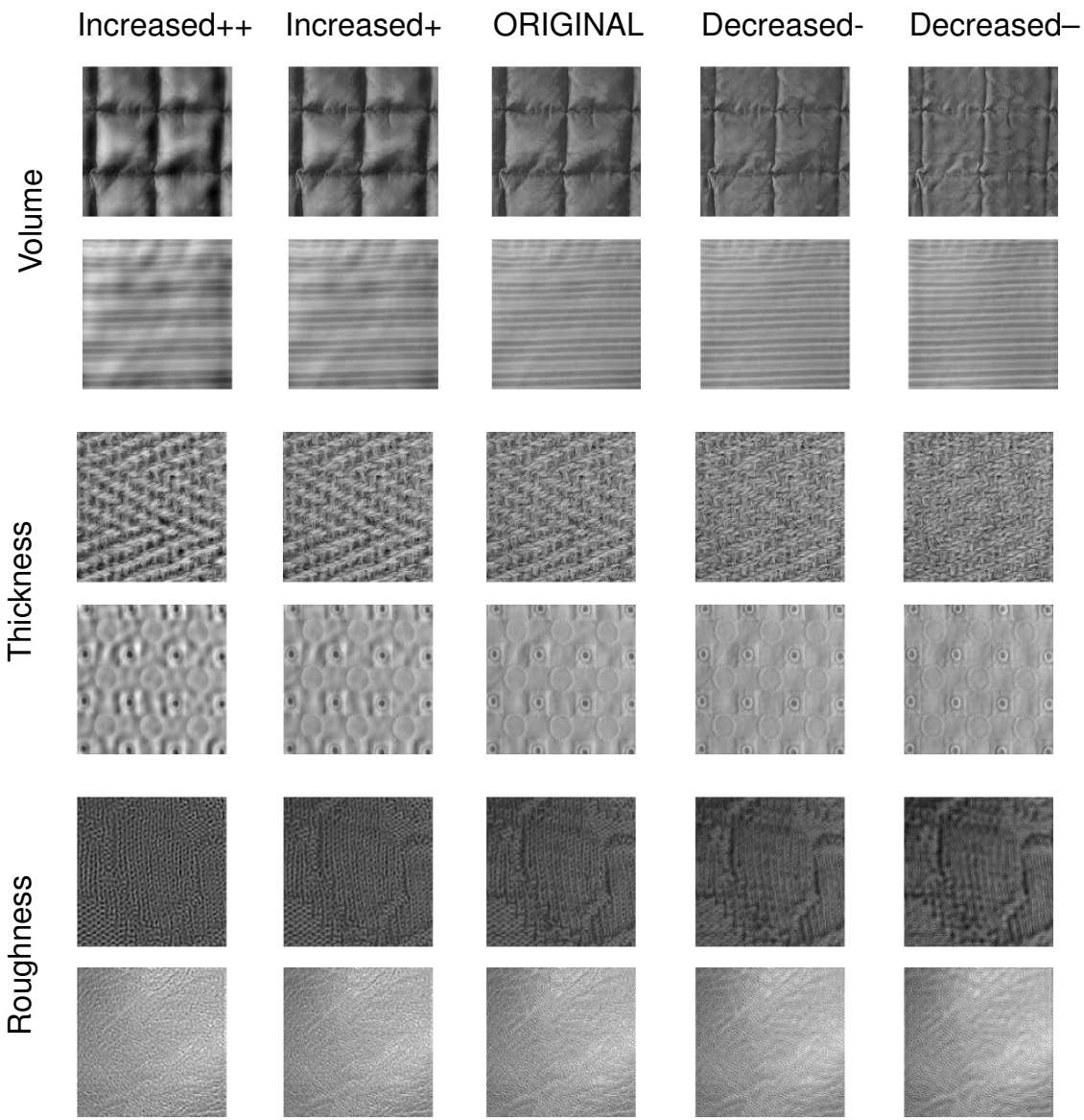
Transfer of structure



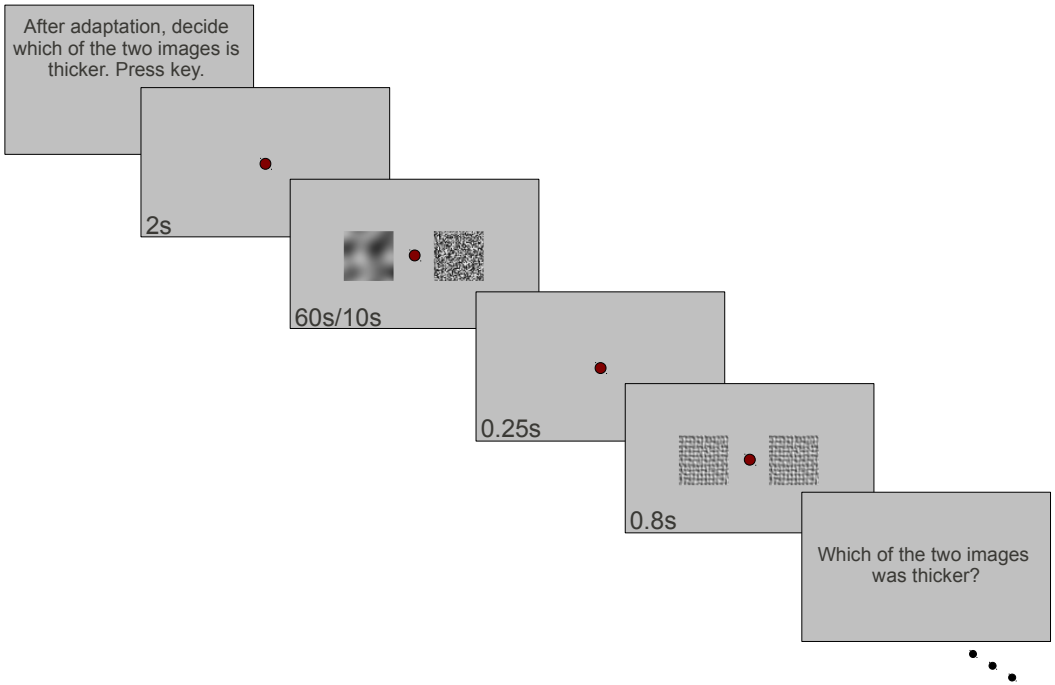




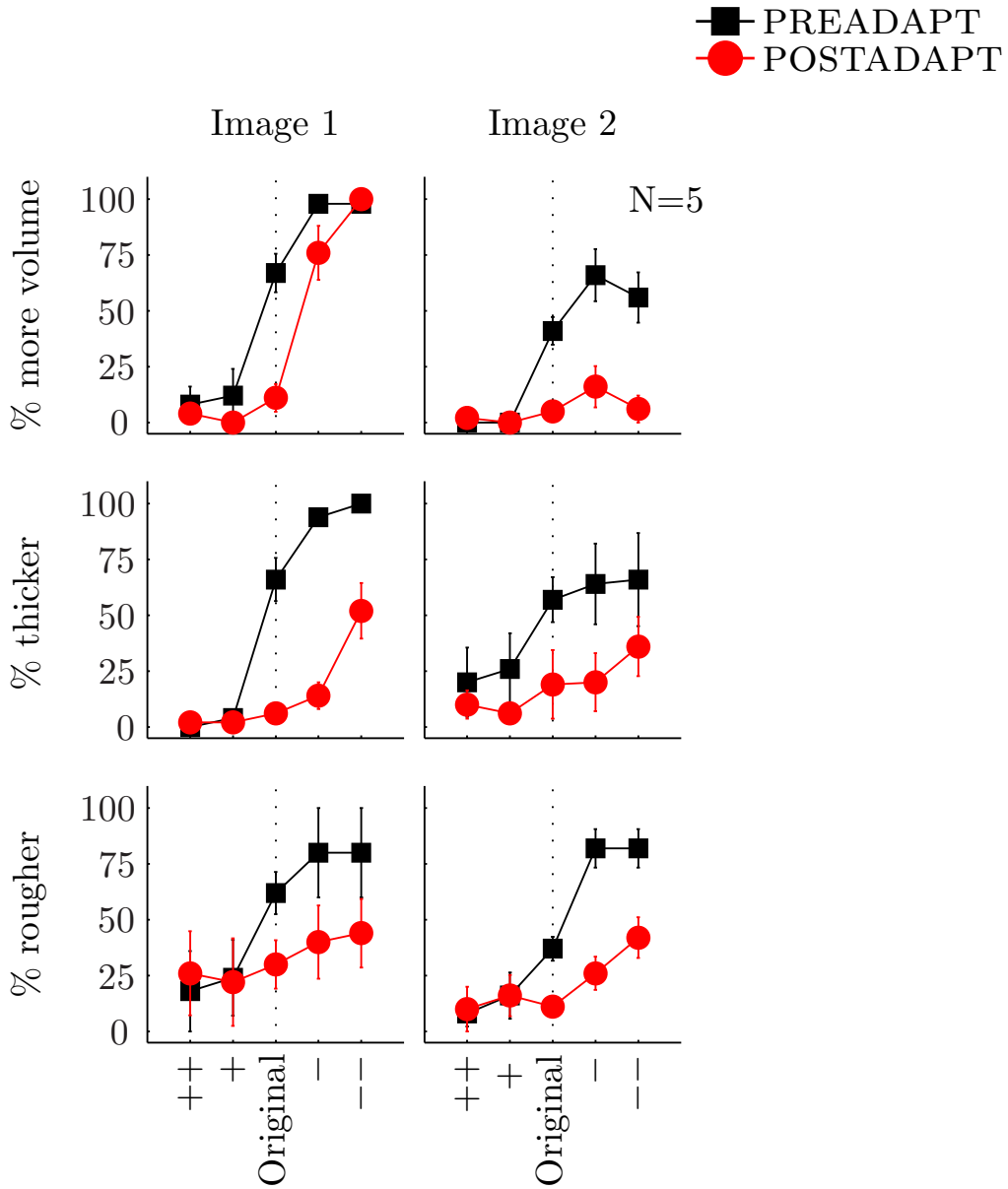
Stimuli


Increased++
Increased+
ORIGINAL
Decreased-
Decreased–
Volume
Thickness
Roughness

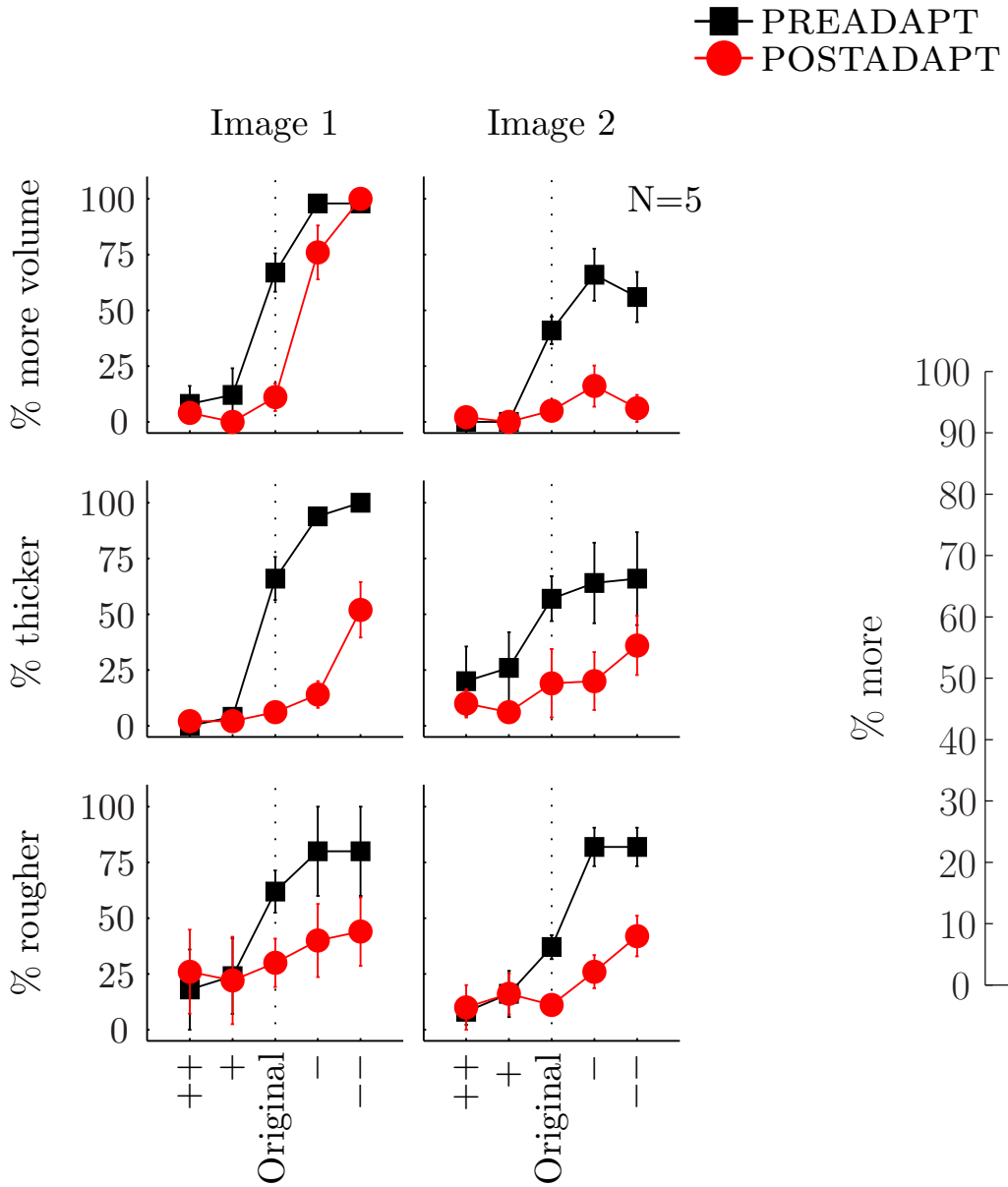
Procedure

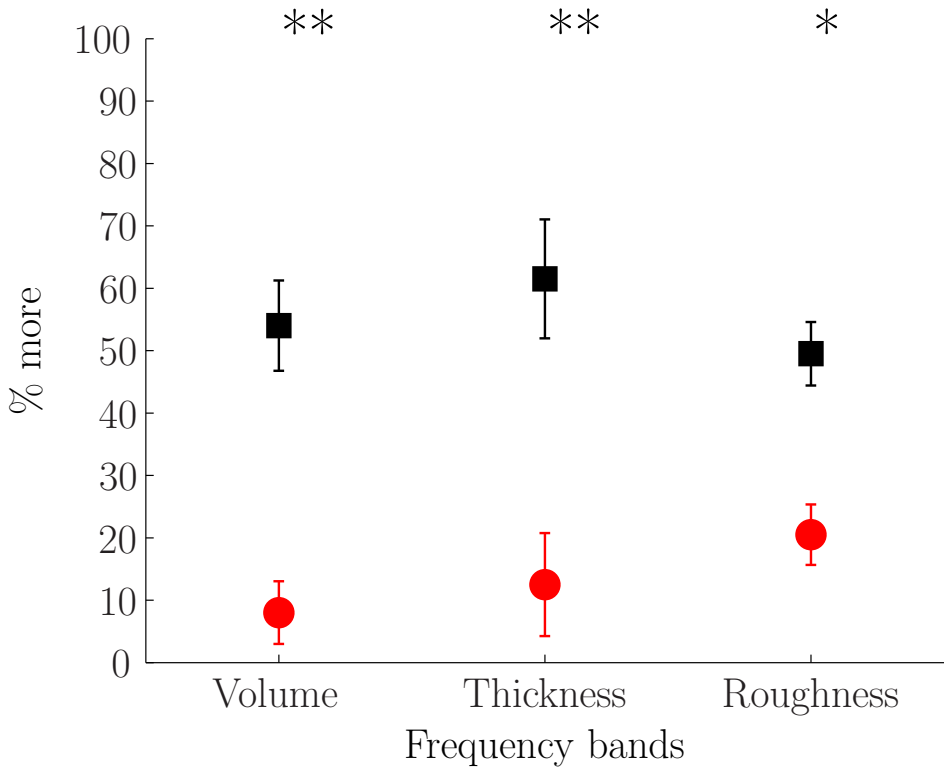

After adaptation, decide which of the two images is thicker. Press key.
2s
60s/10s
0.25s
0.8s
Which of the two images was thicker?

Results


PREADAPT
POSTADAPT
Image 1
Image 2
N=5
% more volume
% thicker
% rougher
100
75
50
25
0
++
+
Original
−
−−

Results


PREADAPT
POSTADAPT
Image 1
Image 2
N=5
% more volume
% thicker
% rougher
100
75
50
25
0
++
+
Original
−
−−


**
**
*
% more
100
90
80
70
60
50
40
30
20
10
0
Volume
Thickness
Roughness
Frequency bands

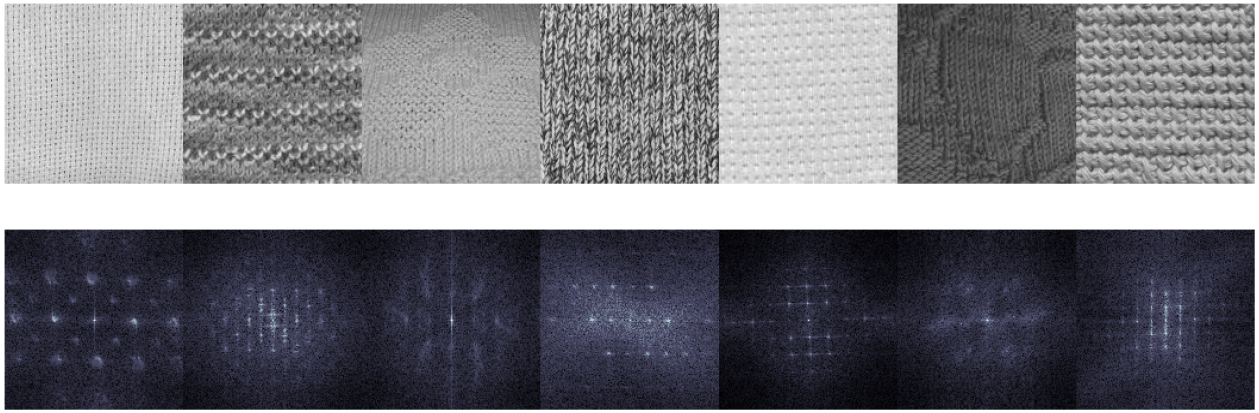
Conclusion

- Spatial frequency information plays a role in the perception of material properties.
- The results demonstrate the importance of spatial structure and scale as opposed to global image statistics.
- Structure at specific spatial scales might be directly related to certain material properties.
- The method of frequency manipulation could be useful for fast and efficient material editing.

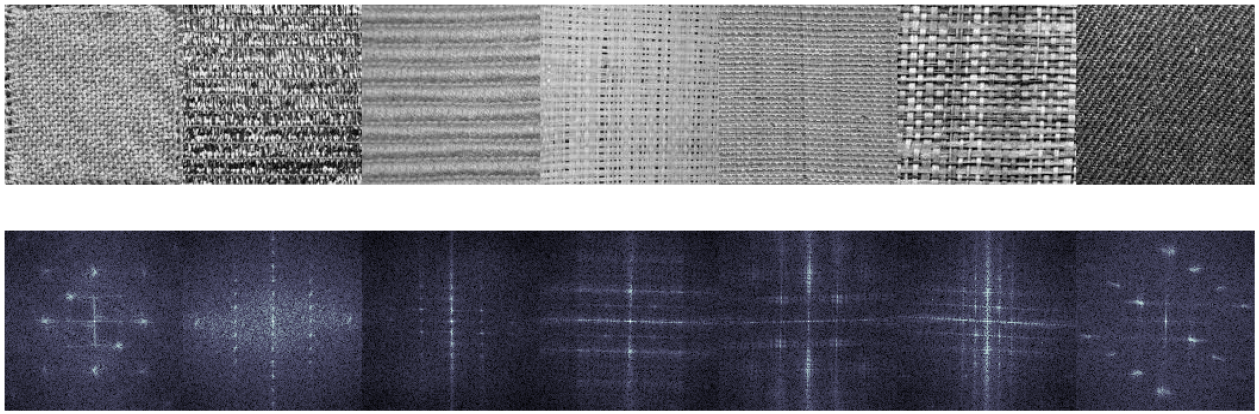
Supported by NEI grants EY07556 & EY13312 to QZ, and DFG Research Fellowship GI 806/1-1 to MG.

Soft and rough knits

SOFT

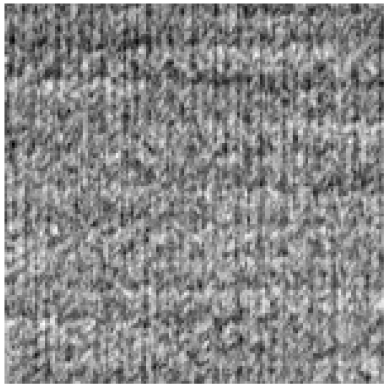


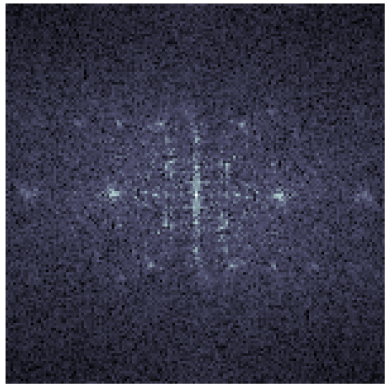
ROUGH



Soft and rough knits

SOFT AVERAGE





ROUGH AVERAGE