



上海交通大学

SHANGHAI JIAO TONG UNIVERSITY



Institute of Media,
Information, and Network



Wavelets and Sparse Signal Processing

Hongkai Xiong

熊红凯

<http://min.sjtu.edu.cn>

Department of Electronic Engineering
Shanghai Jiao Tong University





Hongkai Xiong, distinguished professor

- Office : 1-309, No.1, SEIEE Bld.
- Email: xionghongkai@sjtu.edu.cn
- Web-page: <http://min.sjtu.edu.cn>

Wenrui Dai, associate professor

- Office : 1-304, No.1, SEIEE Bld.
- Email: daiwenrui@sjtu.edu.cn



Teaching Assistants:

- Hao Zhang
Email: zhanghao341@sjtu.edu.cn
- Jiaqi Sun
Email: jiaqisun@sjtu.edu.cn

Office hour:

- 1-304, NO.1, SEIEE Bld.
- 19:00-21:00, Thursday.



Part I - fundamentals

- ❑ Continuous time Fourier transform
- ❑ Discrete time Fourier transform
- ❑ Discrete Fourier transform
- ❑ Z transform



Part II – wavelets and sparse signal processing

- ❑ Time meets frequency
- ❑ Wavelet frames
- ❑ Wavelet zoom
- ❑ Wavelet bases
- ❑ Multiscale geometric analysis
- ❑ Lifting wavelet and filter banks
- ❑ Sparse representation
- ❑ Scattering transform and Convolutional Sparse Coding
- ❑ Graph signal processing



Text books and references

- Stéphane Mallat, **A Wavelet Tour to Signal Processing, The Sparse Way**, Third Edition, Elsevier, 2009
- Michael Elad, **Sparse and Redundant Representations, From Theory to Applications in Signal and Image Processing**, Springer, 2010
- Alan V. Oppenheim, **Signals & Systems**, Second Edition, Publishing House of Electronics Industry of China
- Website: <http://min.sjtu.edu.cn/courses/wt.htm>



Related Sources

- “Sparse and Redundant Representations and Their Applications in Signal and Image Processing”

<https://elad.cs.technion.ac.il/236862-course-webpage-winter-semester-2018-2019/>

- “Wavelets in Signal Processing”

<http://www.ifp.illinois.edu/~minhdo/teaching/wavelets.html>

- “Wavelets, Filter Banks and Applications”

<https://ocw.mit.edu/courses/mathematics/18-327-wavelets-filter-banks-and-applications-spring-2003/>

- <http://www.numerical-tours.com/>



Requirements and grading

- Homework and attendance (20%)
- Projects (40%)
- Final Examination (40%)



■ Projects (report + source code)

Harmonic analysis

Multi-scale geometry analysis

Wavelet and Filter bank design

Compressive sensing

Sparse coding, representation, dictionary learning

Generalized source coding, and subband coding

Multidimensional signal processing

Other relevant topics



- **Final Examination (online)**
 - 3 mandatories + 2 optionals (3 days)
 - Theoretical analysis
 - Algorithm implementations

Q & A



Many Thanks