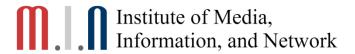




# Wavelets and Sparse Signal Processing

Hongkai Xiong 熊红凯 http://min.sjtu.edu.cn

Department of Electronic Engineering Shanghai Jiao Tong University



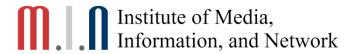


## Hongkai Xiong, distinguished professor

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## Wenrui Dai, associate professor

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



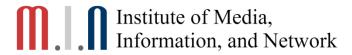


### Teaching Assistants:

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

#### Office hour:

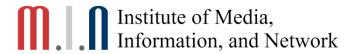
- 1-304, NO.1, SEIEE Bld.
- 19:00-21:00, Thursday.





#### Part I - fundamentals

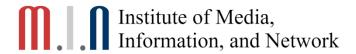
- ☐ Continuous time Fourier transform
- ☐ Discrete time Fourier transform
- ☐ Discrete Fourier transform
- □ Z transform





## Part II – wavelets and sparse signal processing

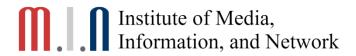
- ☐ Time meets frequency
- Wavelet frames
- □ Wavelet zoom
- Wavelet bases
- Multiscale geometric analysis
- ☐ Lifting wavelet and filter banks
- Sparse representation
- Scattering transform and Convolutional Sparse Coding
- Graph signal processing





#### Text books and references

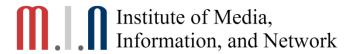
- Stéphane Mallat, A Wavelet Tour to Signal Processing, The Sparse Way, Third Edition, Elsevier, 2009
- Michael Elad, Sparse and Redundant Representations, From Theory to Applications in Signal and Image Processing, Springer, 2010
- Alan V. Oppenheim, Signals & Systems, Second Edition, Publishing House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





#### **Related Sources**

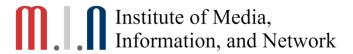
- "Sparse and Redundant Representations and Their Applications in Signal and Image Processing"
   <a href="https://elad.cs.technion.ac.il/236862-course-webpage-winter-semester-2018-2019/">https://elad.cs.technion.ac.il/236862-course-webpage-winter-semester-2018-2019/</a>
- "Wavelets in Signal Processing"
   <a href="http://www.ifp.illinois.edu/~minhdo/teaching/wavelets.html">http://www.ifp.illinois.edu/~minhdo/teaching/wavelets.html</a>
- "Wavelets, Filter Banks and Applications" <a href="https://ocw.mit.edu/courses/mathematics/18-327-wavelets-filter-banks-and-applications-spring-2003/">https://ocw.mit.edu/courses/mathematics/18-327-wavelets-filter-banks-and-applications-spring-2003/</a>
- 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

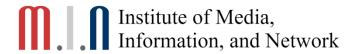
Compressive sensing

Sparse coding, representation, dictionary learning

Generalized source coding, and subband coding

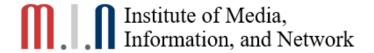
Multidimensional signal processing

Other relevant topics





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



# Q & A



