

AGOSTINHO NETO UNIVERSITY – COLLEGE OF SCIENCES  
MASTER IN MATHEMATICS AND APPLICATIONS

**WAVELETS AND SIGNAL PROCESSING**

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**Classroom:**

<https://zoom.us/j/7245758028?pwd=OXUyRlBkdHhIZWJhMVppY0I1OGFZZz09>

**Course objective:** The objective of this course is to learn some mathematical techniques use in signal processing using local cosine bases and wavelets.

**1. Mathematical tools: Hilbert spaces.** Inner product. Hilbert spaces. Orthogonal projections. Orthonormal systems. Orthonormal bases. Fourier series,

**2. Sampling of signals and images.** Fourier transform. Shannon sampling theorem. Finite signals. Discrete and Fast Fourier transform. Discrete images.

**3. Orthonormal bases to process signals and images.** Continuous bases of sine and cosine. Discrete orthonormal bases. Cosine transform and fast algorithms. JPEG format for images. Coding and entropy

**4. Orthonormal wavelets.** Definition of orthonormal wavelet. Haar and Shannon wavelets. Multiresolution analysis. Filters to build wavelets. Compactly supported wavelets. Null moments of a wavelet and coefficient estimation. The wavelet algorithm. Orthonormal wavelets in two dimensions

**REFERENCES**

- [Br] P. Brémaud, *Mathematical Principles of Signal Processing*, Springer, 2002.  
[Ch] C.K. Chui, *An Introduction to Wavelets*, Academic Press, San Diego, 1992.  
[D] I. Daubechies, *Ten Lectures on Wavelets*, SIAM, 1992.  
[A] A. García García, *Bases en espacios de Hilbert: teoría de muestreo y wavelets*. 2ª Edición, Editorial Sanz y Torres, Madrid, 2014.  
[HW] E. Hernández, G. Weiss. *A first course on Wavelets* CRC Press, 1997.  
[M] S. Mallat. *A Wavelet Tour of Signal Procesing*. 2<sup>nd</sup> Edition. Academic Press, 1999.  
[P] M.A. Pinsky, *Introduction to Fourier Analysis and Wavelets*, The Brooks/Cole Series in Advanced Mathematics, 2002.

**Schedule:** July 5 – July 24, 2021: M, T, W, Th, F, from 5:00 pm to 10:00 pm.

**Note:** The class of Wednesday, July 7, will be replaced by class on Saturday, July 10 from 8:30 am to 11:40 am.

**Evaluation: Control test** on Saturday 17 and Saturday 24 from 8:30 am to 10:00 am. **Final evaluation:** September 2021 (Date to be decided)

**Grades:** Control test and class participation 40%. Final evaluation: 60%