Instructor: Prof. Richard M. Dansereau
Room MC3091, Telephone: (613) 520-2600 x3530, E-mail: rdnse@sce.carleton.ca
Office Hours: TBA


Prerequisites: A basic course in Digital Signal Processing such as SYSC 4405 or SYSC 5602 is a prerequisite.

Learning Outcomes:
- Learn how to analyze and develop multirate signal processing systems
- Learn how to perform multiresolution signal decomposition/expansion using an orthogonal basis
- Learn how to analyze and develop multi-level filter banks
- Learn basics about first-generation wavelet bases, including Haar and Daubechies
- Learn basics about second-generation wavelet transforms with the lifting scheme
- Learn basics about multiresolution and wavelet applications, including edge detection, transform-based signal compression, image compression, transmultiplexers, and signal denoising

Useful Textbook References:
- Martin Vetterli, Jelena Kovačević, and Vivek K. Goyal, Fourier and Wavelet Signal Processing, 2013. URL: http://fourierandwavelets.org/ (under a Creative Commons license)

Grading:
- Assignments: 30% (to be done individually)
- Project: 30% (to be done individually)
- Final Examination: 40%
**Final Exam Policy:** The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

**Course Content (preliminary):**

- Time-frequency distributions, frames, multiresolution approximations, windowed Fourier transform, orthogonal and bio-orthogonal bases
- Multirate signal processing; downsampling and upsampling; general sampling rate conversion; polyphase representation
- Filter banks; perfect reconstruction, two-channel filter banks, mirror filter banks, $M$-band filters, power complementary filters; tree-structured filter banks; pyramid and overcomplete expansions
- Series expansions using wavelets and modulated bases; construction of wavelets, wavelet series and properties
- Second-generation wavelets and the lifting scheme
- Algorithms and complexity; complexity of multirate discrete-time processing, filter banks, and wavelet series computation
- Applications, including edge detection, transform-based signal compression, image compression, transmultiplexers, and signal denoising, multi-dimensional signal processing

**General Regulations**

**Student Responsibility:** It is the student’s responsibility to remain informed of all rules, regulations and procedures required by their program and by the Faculty of Graduate and Postdoctoral Affairs. Ignorance of regulations will not be accepted as a justification for waiving such regulations and procedures.

**Academic Integrity:** Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at [https://carleton.ca/registrar/academic-integrity/](https://carleton.ca/registrar/academic-integrity/). This site also contains a link to the complete Academic Integrity Policy that was approved by the University’s Senate.

**Plagiarism:** Plagiarism (copying and handing in for credit someone else’s work) is a serious instructional offense that will not be tolerated.

**Deferred Term Work:** Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current Graduate Calendar, Academic Regulations of the University, Section 9.3.

**Academic Accommodation:** You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at [http://www.carleton.ca/equity/](http://www.carleton.ca/equity/) For an accommodation request, the processes are as follows:

- **Pregnancy Obligation:** Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see [https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

- **Religious Obligation:** Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see [https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)
• **Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult [https://carleton.ca/pmc/students/dates-and-deadlines/](https://carleton.ca/pmc/students/dates-and-deadlines/) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

• **Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: [https://carleton.ca/sexual-violence-support/](https://carleton.ca/sexual-violence-support/)

• **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see [https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf](https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf)

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**Health and Safety:** Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: [http://sce.carleton.ca/courses/health-and-safety.pdf](http://sce.carleton.ca/courses/health-and-safety.pdf)

**Students from the University of Ottawa:** You can request to have access to cuLearn: please see [http://gradstudents.carleton.ca/forms-policies/](http://gradstudents.carleton.ca/forms-policies/)