THE UNIVERSITY OF BRITISH COLUMBIA

School of Kinesiology

Course Outline

Program: Kinesiology	**Term/Year:** Sept – Dec 2018
Course #: **KIN 500**, Section 001	**Course Title:** Introduction to data acquisition and signal processing in Kinesiology
Day/Time: Tuesdays 9:00am – 12:00am	**Location(s):** Osborne Lab - Gym G
Instructor: Dr. Jean-Sébastien Blouin **Phone:** 604-827-3372 **Email:** jsblouin@mail.ubc.ca **Course Site**: www.connect.ubc.ca	

Course Description:

The focus of this course is to provide Kinesiology students with the tools necessary for data acquisition and signal processing. This course will cover the techniques commonly used in various fields of Kinesiology, including physiology, motor control, neuroscience, biomechanics and motor learning. These techniques include (but are not limited to) sampling theory, Analog-Digital data acquisition, analog and digital filters as well as data analysis techniques. It is assumed that students have an undergraduate background in Kinesiology or related field as well as basic linear algebra and computer skills. Emphasis is placed on laboratory skills, presentation skills and on the development of a research project.

Objectives:

1. Develop the background techniques and tools to acquire and analyse research data.
2. Allow students to present their ideas and results on a topic and have these ideas subjected to evaluation and feedback by their peers.
3. Develop and perform a research project for an in-depth learning of the topics discussed in class.

Expectations:

Students are required to perform weekly laboratory activities and presentations on topics discussed in class. In addition, they need to prepare for the material to be discussed in the roundtable discussions through proposed readings.

Course Evaluation:

A. Weekly or Bi-Weekly Presentations: 40%

Students will lead a 4-minute presentation on the laboratory techniques learned during the preceding week. During the term, students are required to use at least once their least familiar software for data analysis (Matlab or LabVIEW). (Presentations must be performed in Powerpoint or similar program).

B. Presentation of Research Project: 40%

A 15-20 minute oral presentation of the research project. Students will present their research project with a major emphasis on the laboratory and signal processing techniques necessary to analyse their data. (Presentations must be performed in Powerpoint or similar program).

C. Class participation: 20%

Active class participation is required for the good functioning of the course. Students will be graded based on their preparation of the assigned material and participation to in-class roundtable discussions.

Readings:

Readings will consist of book chapters and original research articles from peer-reviewed journals.

Each week, students will be assigned a set of readings. These readings are intended to provide a background overview of the themes and concepts and must be read in preparation for the seminars. Students will facilitate a roundtable discussion and presentation of the topics covered in the assigned readings.

For week 1, students must bring to class a paper that uses a signal processing technique they intend to learn in this class.

Sample list of recommended readings (more may be added throughout the course as appropriate):

- Smith, SW. The Scientist and Engineer's Guide to Digital Signal Processing
  http://www.dspguide.com/pdfbook.htm
- Van Drongelen W. Signal Processing for Neuroscientists. An introduction to the analysis of physiological signals. Elsevier 2007. 308 pages
- Wallisch P, Lusignan M, Benayoun M, Baker TI, Disckey AS, Hatsopoulos NG. MatLab for Neuroscientists. An introduction to scientific computing in Matlab. Elsevier. 2009. 384 pages
- LabVIEW Manuals and Help Guides
  http://www.ni.com/pdf/manuals/320999e.pdf
- Matlab Manuals and Help Guides
  http://www.mathworks.com/help/matlab/index.html
  http://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf
  http://www.mathworks.com/help/pdf_doc/matlab/matlab_prog.pdf
- Bendat JS, Piersol AG. Random data analysis and measurement procedures (3rd Ed). Wiley. 2000. 594 pages
- Siegmund GP. The reflex response of human neck muscles to whiplash-like perturbations. Doctoral thesis, The

University of British Columbia. 2001

- Teasdale N, Bard C, Fleury M, Young DE, Proteau L. Determining Movement Onsets from Temporal Series Journal of Motor Behavior. 1993; 25(2):97-106. DOI:10.1080/00222895.1993.9941644

- Van Boxtel GJ, Geraats LH, Van den Berg-Lenssen MM, Brunia CH. Detection of EMG onset in ERP research. Psychophysiology. 1993 Jul;30(4):405-412.

- Hodges PW, Bui BH. A comparison of computer-based methods for the determination of onset of muscle contraction using electromyography. Electroencephalogr Clin Neurophysiol. 1996 Dec;101(6):511-519.

- Gescheider GA. Psychophysics: The Fundamentals. Taylor & Francis. 1997. 435 pages

- Halliday DM and Rosenberg JR. Time and frequency domain analysis of spike train and time series data (Chap 18). In Modern Techniques in Neuroscience Research. (Eds: Windhorst U & Johanson H). Springer. 1999.

- Winter DA. Biomechanics and Motor Control of Human Movement. Wiley. 2009. 384 pages

- Merfeld DM. Signal detection theory and vestibular thresholds: I. Basic theory and practical considerations. Exp Brain Res. 2011 210(3-4):389-405. doi: 10.1007/s00221-011-2557-7.

- Osborne TM, Lakie M. A novel planar tracking technology for physiological image analysis. J Neurosci Methods. 2011. 202(1):53-9. doi: 10.1016/j.jneumeth.2011.08.041.

- Staude G, Wolf W (1999) Objective motor response onset detection in surface myoelectric signals. Med Eng Phys 21:449-467.

- Staude GH (2001) Precise onset detection of human motor responses using a whitening filter and the log-likelihood-ratio test. IEEE Trans Biomed Eng 48:1292-1305.

Schedule

Week 1	Course Introduction Signal Processing overview and Introduction to Matlab & LabVIEW Readings: • Wallisch P et al. Matlab for Neuroscientists. An introduction to scientific computing in Matlab. Chap 2. • http://www.ni.com/getting-started/labview-basics/ • https://www.youtube.com/watch?v=7bnVx34yQf4
Week 2	Sampling a continuous time signal and Introduction to analog & digital signals. Readings: • Van Drongelen W. Signal Processing for Neuroscientists. An introduction to the analysis of physiological signals. Chap 1 & 2 • Smith, SW. The Scientist and Engineer’s Guide to Digital Signal Processing. Chap 3. • http://www.ni.com/white-paper/52648/en/ • http://www.ni.com/product-documentation/2835/en/
Week 3	Preliminary findings, Tutorial & Discussions on Sampling a continuous time signal and Introduction to analog & digital signals.
Week 4	Synchronization of data from different sources Readings: • Osborne TM, Lakie M. A novel planar tracking technology for physiological image analysis. J Neurosci Methods. 2011. 202(1):53-9. doi: 10.1016/j.jneumeth.2011.08.041. • Abraham L, Kalakanis D. Synchronization Of Video Kinematic And Analog Biomechanical Data Using The Motion Analysis System. International Symposium on Biomechanics in Sports (1993) • http://www.ni.com/product-documentation/4322/en/ • http://www.ni.com/tutorial/11549/en/ • http://www.ni.com/white-paper/11369/en/
Week 5	Preliminary findings, Tutorial & Discussions on Synchronization of data from different sources
Week 6	Data analysis, noise & signal averaging Readings: • Van Drongelen W. Signal Processing for Neuroscientists. An introduction to the analysis of physiological signals. Chap 3 & 4 • Smith, SW. The Scientist and Engineer’s Guide to Digital Signal Processing. Chap 2 & 4.
Week 7	Continuous, discrete and Fast Fourier Transform. Brief overview of correlation in the time and frequency domains. Readings: • Van Drongelen W. Signal Processing for Neuroscientists. An introduction to the analysis of physiological signals. Chap 5, 6, 7 & 8 • Smith, SW. The Scientist and Engineer’s Guide to Digital Signal Processing. Chap 5-6-8-9-10 & 12. • Wallisch P et al. Matlab for Neuroscientists. An introduction to scientific computing in Matlab. Chap 7 & 10.

Week 8	Preliminary findings, Tutorial & Discussions on Continuous, discrete and Fast Fourier Transform
Week 9	Introduction to filters & filter analysis. The RC circuit & Digital filters Readings: • Van Drongelen W. Signal Processing for Neuroscientists. An introduction to the analysis of physiological signals. Chap 10, 11, 12 & 13 • Smith, SW. The Scientist and Engineer's Guide to Digital Signal Processing. Chap 3, 14, 15, 16, 17, 19, 20 & 21.
Week 10	Preliminary findings, Tutorial & Discussions on Introduction to filters & filter analysis. The RC circuit & Digital filters
Week 11	Research Project
Week 12	Research Project
Week 13	Research Project
Week 14	Research Project Presentations