



# TENSS 2013

## Final program

Color code:    **General**    **Lectures**    **Labs**    **Student presentations**

**June 1-17, 2013, Pike Lake, Romania**

**[www.tenss.ro](http://www.tenss.ro)**



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## Saturday – June the 1<sup>st</sup>

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08:00 – 09:00 Breakfast

09:00 – 10:00

Introduction – Florin Albeanu, Raul Mureşan, Adam Kampff

10:00 – 11:15

Diffraction & Resolution - Florin Albeanu

11:15 – 11:30 Coffee break

11:30 – 13:00

Basic Optics: Lenses & Mirrors - Florin Albeanu

13:00 – 14:00 Lunch

14:00 – 17:00

Lenses, combinations of lenses, microscopes

17:00 – 17:30 Coffee break

17:30 – 18:30

Koehler Illumination and Numerical aperture – Priyanka Gupta

18:30 – 20:30

Bench-top microscopes, Koehler illumination – depth of field and apertures

20:30 – 21:15

The EU Directive and the future for responsible animal research in Europe – Roger Lemon

21:15 – 22:00 Dinner

22:00 – 23:00

Recap: Diffraction, Resolution, Numerical aperture, Objectives – Priyanka Gupta

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## Sunday – June 2<sup>nd</sup>

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08:00 – 09:00 Morning run/swim

09:00 – 10:00 Breakfast

10:00 – 11:15

Wide-field imaging: Fluorescence, Epi-fluorescence, PSFs and Resolution – Ashesh Dhawale



**11:15 – 11:30 Coffee break**

**11:30 – 13:00**

Detecting signals: methods and limitations - Noise, Cameras, PMTs and Diodes – Adam Kampff

**13:00 – 14:00 Lunch**

**14:00 – 16:30**

Convert bench-top Koehler bright light microscopes to wide-field epi-fluorescence

**16:30 – 17:00**

Characterization of noise sources and PSFs of your microscope, intro to ImageJ – Adam Kampff

**17:00 – 17:30 Coffee**

**17:30 – 20:30**

Noise measurements, measure PSFs using fluorescent beads

**20:30 – 21:30 Dinner**

**21:30 – 23:00**

Discussion, analysis, ...

## Monday – June 3<sup>rd</sup>

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**08:00 – 09:00 Morning run/swim**

**09:00 – 10:00 Breakfast**

**10:00 – 11:30**

Fluorescent probes: GFP, calcium indicators vs. voltage dyes, synaptophluorins – Florin Albeanu

**11:30 – 11:45 Coffee**

**11:45 – 13:00**

Making sense of fluorescence: bleaching,  $dF/F$ , ratiometry ( $dF/dR$ ) – Ashesh Dhawale

**13:00 – 14:00 Lunch**

**14:00 – 15:00**

Image fixed brain slices on the bench-top fluorescence microscopes

**15:00 – 17:00**

Compare noise and PSFs on commercial Scientifica and Olympus microscopes (1-2 students per group can combine and do this together)



**In parallel, all groups analyze noise and PSF measurements, compile results and make presentations**

**17:00 – 17:30 Coffee**

**17:30 – 20:30**

**Continuation of analysis and making presentations**

**In parallel, in vivo Wide-field imaging – interactive demo by TAs (2 groups at a time)**

**20:30 – 21:30 Dinner**

**21:30 – 23:00**

**Student presentations (15 + 5 minutes): PSFs, noise characterization of wide-field microscopes**

## **Tuesday – June 4<sup>th</sup>**

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**08:00 – 09:00 (early) Breakfast (can be preceded by an even earlier morning run and swim)**

**09:00 – 12:00 Bus trip to Alba Iulia**

**12:00 – 15:30 Visit of the Alba Carolina Fortress**

**15:30 – 17:30 Bus trip to Cluj-Napoca**

**17:30 – 22:00 Transylvanian International Film Festival (TIFF) – free exploration**

**22:00 – 23:00 Bus trip back to Pike Lake**

**23:00 – 24:00 Dinner**

## **Wednesday – June 5<sup>th</sup>**

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**08:00 – 09:00 Morning run/swim**

**09:00 – 10:00 Breakfast**

**10:00 – 11:30**

**Wide-field imaging of Intrinsic optical signals - Mark Hübener**

**11:30 – 11:45 Coffee**

**11:45 – 13:00**

**Research Talk – Mark Hübener**

**13:00 – 14:00 Lunch**



**14:00 – 15:00 [Groups A/B]**

**Practical aspects of intrinsic optical imaging – contrast with wide-field epifluorescence (discussion) – Florin Albeanu**

**15:00 – 17:00 [Groups A/B]**

**Set up microscopes for intrinsic optical imaging and determine optimal imaging parameters**

**14:00 – 15:00 [Groups C/D]**

**Introduction to Labview – Adam Kampff**

**15:00 – 17:00 [Groups C/D]**

**Basic programming exercises in Labview**

**17:00 – 17:30 Coffee**

**17:30 – 20:30 [Groups A/B]**

**In-vivo intrinsic optical imaging and analysis of acquired data to extract functional responses**

**17:30 – 20:30 [Groups C/D]**

**Programming exercises in Labview geared towards sending and acquiring analog and digital signals, writing scanning, image acquisition, motion detection software**

**20:30 – 23:00 Dinner & concert**

## **Thursday – June 6<sup>th</sup>**

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**08:00 – 09:00 Morning run/swim**

**09:00 – 10:00 Breakfast**

**10:00 – 11:30**

**Scanning and confocal microscopy – Adam Kampff**

**11:30 – 11:45 Coffee**

**11:45 – 13:00**

**Viral approaches to monitor and reconstruct neuronal circuits – Botond Roska**

**13:00 – 14:00 Lunch**

**14:00 – 15:00 [Groups A/B]**

**Introduction to Labview – Adam Kampff**

**15:00 – 17:00 [Groups A/B]**

**Basic programming exercises in Labview**



**14:00 – 15:00 [Groups C/D]**

**Practical aspects of intrinsic optical imaging – contrast with wide-field epifluorescence (discussion) – Florin Albeanu**

**15:00 – 17:00 [Groups C/D]**

**Set up microscopes for intrinsic optical imaging and determine optimal imaging parameters**

**17:00 – 17:30 Coffee**

**17:30 – 20:30 [Groups A/B]**

**Programming exercises in Labview geared towards sending and acquiring analog and digital signals, writing scanning, image acquisition, motion detection software**

**17:30 – 20:30 [Groups C/D]**

**In-vivo intrinsic optical imaging and analysis of acquired data to extract functional responses**

**20:30 – 21:30 Dinner**

**21:30 – 23:00**

**Research Talk – Simon Rumpel**

## **Friday – June 7<sup>th</sup>**

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**08:00 – 09:00 Morning run/swim**

**09:00 – 10:00 Breakfast**

**10:00 – 11:30**

**Two-photon microscopes – the THEORY – Adam Kampff**

**11:30 – 11:45 Coffee**

**11:45 – 13:00**

**Two-photon microscopes – the ASSEMBLY – Florin Albeanu**

**13:00 – 14:00 Lunch**

**14:00 – 17:00 [Groups A/B]**

**Write X-Y scanning and image acquisition software in Labview**

**14:00 – 17:00 [Groups C/D]**

**Build your own two-photon microscope (1 microscope per group)**

**17:00 – 17:30 Coffee**



**17:30 – 20:30**

**Continuation of lab session**

**20:30 – 21:30** Dinner

**21:30 – 23:00**

**Two-photon microscopes – the NEUROSCIENCE – Tom Mrsic-Flögel**

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## **Saturday – June 8<sup>th</sup>**

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**08:00 – 09:00** Morning run/swim

**09:00 – 10:00** Breakfast

**10:00 – 11:30**

**Introduction to Optogenetics – Venki Murthy**

**11:30 – 11:45** Coffee

**11:45 – 13:00**

**Applications of Optogenetics – Venki Murthy**

**13:00 – 14:00** Lunch

**14:00 – 17:00** [Groups A/B]

**Build your own two-photon microscope (1 microscope per group)**

**14:00 – 17:00** [Groups C/D]

**Write X-Y scanning and image acquisition software in Labview**

**17:00 – 17:30** Coffee

**17:30 – 20:30**

**Continuation of lab session**

**20:30 – 21:30** Dinner

**21:30 – 23:00**

**Research talk – Sonja Hofer**



## Sunday – June 9<sup>th</sup>

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08:00 – 09:00 Morning run/swim

09:00 – 10:00 Breakfast

10:00 – 11:00 [Groups A/B]

Measure PSFs on the custom two-photon microscopes

11:00 – 13:00 [Groups A/B]

Image fixed slices on the custom two-photon microscopes, single and multi-plane

10:00 – 11:30 [Group C]

Measure PSFs and image brain slices on the Scientifica two-photon microscope

11:30 – 13:00 [Group C]

Demo of 3-D scanning - Femtonics two-photon microscope

10:00 – 11:30 [Group D]

Demo of 3-D scanning - Femtonics two-photon microscope

11:30 – 13:00 [Group D]

Measure PSFs and image brain slices on the Scientifica two-photon microscope

13:00 – 14:00 Lunch

14:00 – 15:30 [Group A]

Measure PSFs and image brain slices on the Scientifica two-photon microscope

15:30 – 17:00 [Group A]

Demo of 3-D scanning - Femtonics two-photon microscope

14:00 – 15:30 [Group B]

Demo of 3-D scanning - Femtonics two-photon microscope

15:30 – 17:00 [Group B]

Measure PSFs and image brain slices on the Scientifica two-photon microscope

14:00 – 15:00 [Groups C/D]

Measure PSFs on the custom two-photon microscopes

15:00 – 17:00 [Groups C/D]

Image fixed slices on the custom two-photon microscopes, single and multi-plane

17:00 – 17:30 Coffee

17:30 – 18:30

All groups compile results and make presentations for next day's student presentations.  
In parallel, TAs prepare for in-vivo two-photon imaging demo





18:30 – 20:30 [Group A/B]

**In vivo two-photon imaging on custom two-photon microscopes**

18:30 – 20:30 [Group C/D]

**Continue making presentations/Discussions**

20:30 – 21:30 Dinner

21:30 – 23:30 [Group A/B]

**Continue making presentations/Discussions**

21:30 – 23:30 [Group C/D]

**In vivo two-photon imaging on custom two-photon microscopes**

## Monday – June 10<sup>th</sup>

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08:00 – 09:00 Morning run/swim

09:00 – 10:00 Breakfast

Groups will have half of the day OFF. Two groups in the morning, two in the late afternoon. They can use this time at their own leisure to relax, explore Pike Lake, swim ...

10:00 – 10:30 [Group A/B]

**How to use a projector for pattern illumination – Ashesh Dhawale**

10:30 – 13:00 [Group A/B]

**Assemble a DLP-based patterned illumination setup**

13:00 – 14:00 [Group A/B] Lunch

14:30 – 15:30 [Group C/D] Late Lunch (Can also join with earlier groups if very hungry!)

15:30 – 16:00 [Group C/D]

**How to use a projector for pattern illumination – Ashesh Dhawale**

16:00 – 18:30 [Group C/D]

**Assemble a DLP-based patterned illumination setup**

18:30 – 20:30

**LASERS and more – Florian Engert**

20:30 – 21:30 Dinner

21:30 – 23:00

**Student presentations (15 + 5 minutes): Experiences and results from 2p imaging**



## Tuesday – June 11<sup>th</sup>

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08:00 – 09:00 Morning run/swim

09:00 – 10:00 Breakfast

10:00 – 12:00

Biophysics of neurons and computation modeling of neurons – Upi Bhalla

12:00 – 12:15 Coffee

12:15 – 13:00

Impedance and Dipoles– Adam Kampff

13:00 – 14:00 Lunch

14:00 – 15:00

Introduction to Amplifiers and details about the following lab session – Mehrab Modi

15:00 – 17:30 [Group A/B]

Cell in a dish: Bench top electronics and basics of electrophysiology

15:00 – 16:00 [Group C/D]

Practical aspects of extracellular recordings: tetrodes, plating and microdrives – Balázs Hangya

16:00 – 17:30 [Group C/D]

How to make and plate tetrodes and assemble microdrives

17:30 – 18:00 Coffee

18:00 – 19:00 [Group A/B]

Practical aspects of extracellular recordings: tetrodes, plating and microdrives – Balázs Hangya

19:00 – 20:30 [Group A/B]

How to make and plate tetrodes and assemble microdrives

18:00 – 20:30 [Group C/D]

Cell in a dish: Bench top electronics and basics of electrophysiology

20:30 – 21:30 Dinner

21:30 – 23:00

Patch clamp recordings: slices, in vivo anesthetized and awake – Tomáš Hromádka



## Wednesday – June 12<sup>th</sup>

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08:00 – 09:00 Morning run/swim

09:00 – 10:00 Breakfast

10:00 – 11:30

Single Unit, Multi-unit and Field recordings – Upi Bhalla

11:30 – 11:45 Coffee

11:45 – 12:30

Detecting spikes, PSTH, Basics of spike Sorting – Danko Nikolić

12:30 – 13:30 Lunch

14:00 – 17:00 [Group A/B]

**Monitoring animal behavior with Adam Kampff - session I**

The students will setup and program a simple behavioral assay that includes video, based on either place conditioning or shuttling. They will learn the basics of animal training, how to design a camera/illumination system, and some additional programming concepts (state machines) not covered in the first weeks

14:00 – 17:00 [Group C/D]

**In vivo patch clamp recordings with Tomáš Hromádka**

17:00 – 17:30 Coffee

17:30 – 20:30 [Group A/B]

**In vivo patch clamp recordings with Tomáš Hromádka**

17:30 – 20:30 [Group C/D]

**Monitoring animal behavior with Adam Kampff - session I**

20:30 – 21:30 Dinner

21:30 – 22:30 [Group A/B]

**Set up recording system on the DLP rig – Priyanka, Balázs, Tina, Mehrab**

22:30 – 23:30 [Group A/B]

**Set up multi-electrode recordings for day15 – Raul, Danko, Ovidiu, Vlad**

21:30 – 22:30 [Group C/D]

**Set up recording system on the DLP rig – Priyanka, Balázs, Tina, Mehrab**

22:30 – 23:30 [Group C/D]

**Set up multi-electrode recordings for day15 – Raul, Danko, Ovidiu, Vlad**



## Thursday – June 13<sup>th</sup>

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**08:00 – 09:00 Early Breakfast (can be preceded by an even earlier morning run and swim)**

**09:00 – 10:15**

**Introduction to mathematical modeling of biological systems – Remus Oşan**

**10:15 – 11:30**

**Modeling Neuronal Circuits – Jochen Triesch**

**11:30 – 11:45 Coffee**

**11:45 – 13:00**

**Research talk – Hannah Monyer**

**13:00 – 14:00 Lunch**

**14:00 – 17:00 [Group A/B]**

**Monitoring animal behavior with Adam Kampff - session II**

Students acquire and analyze video data from different assays: time-lapse/high-speed etc. They will learn computer vision techniques for tracking and segmentation that are not introduced during the imaging section, but highly relevant to behavioral studies. Run assay from the previous day and then start analyze results.

**14:00 – 17:00 [Group C/D]**

**In vivo extracellular recordings with optogenetics and DLPs – session I**

Students will record light-evoked or sensory stimulus evoked spikes. Visualize/hear spikes on oscilloscope/speakers. Use manual photo-stimulation (Hubel-Wiesel style) and pre-written simple Labview software. Extract spike times and stimulus time-stamps and detect stimulus-triggered responses.

**17:00 – 17:30 Coffee**

**17:30 – 20:30 [Group A/B]**

**In vivo extracellular recordings with optogenetics and DLPs – session I**

**17:30 – 20:30 [Group C/D]**

**Monitoring animal behavior with Adam Kampff - session II**

**20:30 – 21:30 Dinner**



**21:30 – 24:00**

**Extracellular recordings from freely moving mice – session I**

**Groups A/B combine with Balázs, Groups C/D combine with Tina.**

Students will familiarize themselves with the set-up and the implanted mice. They will plug in the animal and study the signal (oscillations, spikes, artifacts etc.). They will get the mouse to cover the open field arena, study the signal during different behavioral states and record some data while training. Students should think about the type of data they can generate and what they want to record the next day.

## Friday – June 14<sup>th</sup>

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**08:00 – 09:00** Early Breakfast (can be preceded by an even earlier morning run and swim)

**09:00 – 10:15**

General aspects about synchrony and oscillations – Wolf Singer

**10:15 – 11:30**

Synchrony and oscillations in cat visual cortex – Danko Nikolić

**11:30 – 11:45** Coffee

**11:15 – 12:15**

Analysis Lecture I: Rate Codes, Temporal Codes, Combinatorial Codes – Raul Mureşan

**12:15 – 13:00** Lunch

**13:15 – 16:00** [Group A/B]

**Monitoring animal behavior with Adam Kampff - session III**

Students learn how to build the real-time systems necessary for creating closed-loop environments. Compare preference of the animal for environments in which this closed-loop control is delayed vs. normal, etc. Program/test this assay and run animals in these "weird", albeit highly controlled environments.

**13:00 – 16:00** [Group C/D]

**In vivo extracellular recordings with optogenetics and DLPs – session II**

Students will spatially map the receptive field of individual neurons using randomized, single-spot or multi-spot patterned illumination. Also construct dose response curves with different light/stimulus intensities.

**16:00 – 16:15** Coffee



**16:15 – 17:30**

**Specificity and function of synaptic and extra synaptic GABA receptors – Istvan Mody**

**17:30 – 20:30 [Group A/B]**

**In vivo extracellular recordings with optogenetics and DLPs – session II**

**17:30 – 20:30 [Group C/D]**

**Monitoring animal behavior with Adam Kampff - session III**

**20:30 – 21:30 Dinner**

**21:30 – 24:00**

**Extracellular recordings from freely-moving mice – session II**

**Groups A/B combine with Balázs, Groups C/D combine with Tina**

Record freely-moving mice in the open field while tracking the position (to record place cells and theta oscillations) and listen to place cells. Record mice in a rest box (to record sharp wave ripples). And record under whatever conditions they came up with the day before. Take the recorded data from the day before and understand how the data has been/is being processed. Cluster spikes. They should figure out what they want to do with the data generated today (place cell heat maps, autocorrelations, phase histograms, power spectrum of the lfp and whatever other stuff they come up with) while looking at the processed data from day 13.

## **Saturday – June 15<sup>th</sup>**

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**08:00 – 09:00 Early Breakfast (can be preceded by an even earlier morning run and swim)**

**09:00 – 10:00**

**Analysis Lecture II: Oscillations – Raul Mureşan**

**10:00 – 13:00 [Group A/B]**

**Extracellular recordings from visual cortex with multi-electrode arrays**

Students will record data from the visual cortex of anesthetized mice, while the animals are stimulated with drifting gratings, graphemes and natural movies. After extracting spiking activity, students will use crosscorrelation analysis to detect time-delays in the firing of neurons, under the different stimulation conditions.

**10:00 – 13:00 [Group C/D]**

**Extracellular recordings in freely-moving mice – session III**

Students can record more data if they want. They need to process, cluster and analyze the data from day 14. Generate heat maps that encode firing rate with respect to the position of the mouse to visualize place fields of place cells. Compute autocorrelations of cells, phase histograms to see modulation of firing depending on the ongoing oscillations. If time is left, they can do some more complex analyses: from crosscorrelation analysis to theta phase precession.



13:00 – 14:00 Lunch

14:00 – 17:00 [Group A/B]

**Extracellular recordings in freely-moving mice – session III**

14:00 – 17:00 [Group C/D]

**Extracellular recordings from visual cortex with multi-electrode arrays**

17:00 – 17:30 Coffee

17:30 – 21:30

**Analysis of ephys and behavior data**

20:30 – 21:30 Dinner

21:30 – 23:30

**Analysis of ephys and behavior data continues, make presentations**

## Sunday – June 16<sup>th</sup>

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08:00 – 09:00 Morning run/swim

09:00 – 10:00 Breakfast

10:00 – 11:15

**Research Lecture – Bruce McNaughton**

11:15 – 11:30 Coffee

11:30 – 13:00

**'Florian' speaks**

13:00 – 14:00 Lunch

14:00 Trip to Cluj

**Open Debate in Cluj: Top-Down or Bottom-Up regulation of neuronal circuits? Led by Bruce McNaughton and Hannah Monyer**

20:00 – 21:00 Dinner

21:00 – 23:00

**Student presentations (15 + 5 minutes): Experiences and results from ephys and behavior**



## Monday – June 17<sup>th</sup>

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**08:00 – 09:00** Morning run/swim

**09:00 – 10:00** Breakfast

**10:00 – 11:45**

**Informal chalkboard talks by students (10 + 5 minutes): Very brief intro to current research work and defend future proposals to use knowledge acquired at the course**

**11:45 – 12:00** Coffee

**12:00 – 13:30**

**Informal chalkboard talks by students continue**

**13:30 – 14:30** Lunch

**14:30 – 16:00**

**Round up and feedback**

**Evening**

**Music, movies, swim and party & concert**