ISCH Action TD0904
Time In MEntaL activitY: theoretical, behavioral, bioimaging and clinical perspectives (TIMELY)

TIMELY Workshop on
"Dynamical systems for psychological timing and timing in speech processing"
Vietri sul Mare (IT), May 2-4, 2012

Organized by Mark A Elliott, Anna Esposito & Argiro Vatakis

Information, Programme, Activities, & Abstracts

VENUE

Location: International Institute for Advanced Scientific Studies Vietri sul Mare (IT). Via Pellegrino 19, 84019 Vietri sul Mare Salerno, phone : + 39 089 761167, fax: + 39 089 761189

Accommodation and Travel

For accommodation please contact Mr Andrea Senatore (andrea – at - hotellalucertola.it), manager of the hotel "La Lucertola" using reference "TIMELY school at IIASS" and ccing to iiass.segreteria – at - tin.it and iiass.annaesp – at - tin.it (this allows us to trouble shoot if necessary). Reference to the TIMELY summer school allows you to avail of discounted rates €70 single and €80 double room per night (bed and breakfast). The hotel can provide lunch and dinner on request and is 2 minutes walking distance from the School venue.
HOTEL ADDRESS: Hotel La Lucertola, Via Colombo 25, Vietri sul Mare, Salerno
http://www.hotellalucertola.it/home.htm
Phone: + 39 089 210 255
Fax: + 39 089 210223
emails: INFO@HOTELLALUCERTOLA.IT ; andrea@hotellalucertola.it;

For flights, the nearest airport is Naples-Capodichino with several carriers, including Alitalia connecting Naples to other Italian and European cities. Information is available from http://www.portal.gesac.it/portal/page/portal/internet/inVOLO/DestinazioniCompagnie An alternative to this is Rome Leonardo da Vinci airport http://www.rome-airport.info/ and then by train (http://www.rome-airport.info/).

General queries on accommodation and travel may be directed Anna Esposito (iiass.annaesp – at - tin.it) with the subject title TRAVEL/ACCOMMODATION QUERY: TIMELY TRAINING SCHOOL SALERNO

Reaching Vietri from Naples airport:

You can choose among the following three options:

1. Take the bus from Naples Airport (Capodichino) to Vietri. The bus stop is in front to the airport arrival exit. The bus runs from Naples airport to Salerno and stops in Vietri in front of the "Ceramica Solimene Building". However, note that there are only 4 departures per day. The bus schedule can be checked at: http://www.salernoturismo.it/vis_dettaglio.php?id_livello=906 . The stop is Vietri sul Mare in front of the Building "Ceramica Solimene". Crossing the street you will be in Vietri. From there, to reach the Hotel La Lucertola read the instructions at the end of this page

2. From Naples Airport (Capodichino) travel to Salerno Railway Station and then Vietri

From Naples Airport (Capodichino) go to Napoli Railway Station (Napoli Centrale). You can then take one of the two available orange buses (ALIBUS, departing every 15 minutes – cost €3, Local Bus no. 58 (on the half hour) – cost €1.20). The stop is in front of the Airport arrival exit. Tickets are sold inside the Airport at the information desk where you can also get tickets for local trains to Salerno at €4. These can also be used for the local bus and the train to Salerno without additional costs. Get off at the "Piazza Garibaldi" (Garibaldi Square) and walk towards the Napoli Railway Station (Napoli Centrale). From there you can catch a local train (Local train categories are listed as IR, R, RV, on the train schedule, For IC, ES trains you must buy a ticket at the Naples railway station) to Salerno Railway Station (Salerno). The train schedule can be found at: http://www.fsitaliane.it/homepage_en.html . Get off at Salerno and from there you can reach Vietri following the instructions below. (Remember to stamp the ticket at the yellow machines BEFORE getting on the train)

3. From Naples Airport (Capodichino) to VIETRI city
Take one of the two available orange buses (ALIBUS, departing every 15 minutes – cost €3, Local Bus no. 58 (on the half hour) – cost €1.20). The stop is in front of the Airport arrival exit. Tickets are sold inside the Airport at the information desk, in front of the Arrivals exit. If you want to take the bus SITA NAPOLI SALERNO VIA NOCERA you can get off at Napoli Railway Station and ask for the SITA Stops. There, there are regular buses of the SITA (http://www.sitabus.it/wps/portal) company that reach Vietri. The bus line is Napoli-Salerno via Nocera (don't confuse this with Napoli-Salerno via Autostrada that does not stop in Vietri). Ask the driver, to stop in front of the CERAMICA SOLIMENE building. Crossing the street you are in Vietri.
To reach the Hotel La Lucertola read the instructions below
The bus time schedule is
http://www.sitabus.it/sitabus/campania/orarioCAMPANIA/QUADROVIII_BIS.pdf

Reaching Vietri from Rome airport:

To get to Salerno Railway Station from Rome Airport (Leonardo da Vinci) there are the following two options.

1. From Rome FIUMICINO Airport (Leonardo da Vinci) you first need to go to Roma Railway Station (Roma Termini). This is achievable by train; a taxi is not recommended since it could be very. From inside the Airport, close to TERMINAL C there are trains from the airport to Rome Railway Station (Roma Termini) any 30 minutes. Tickets must be bought at the FS office (about €9) and stamped at the yellow machines before getting on the train. At the same office you can also buy the train ticket from Rome Railway Station (Roma Termini) to Salerno Railway Station (Salerno). In addition you can buy both the tickets on the FS website http://www.fsitaliane.it/homepage_en.html . Once in Rome Railway Station (Roma Termini) check for the platform from where the trains to Salerno Railway Station (Salerno) depart. Please check for train schedules from Rome

Airport to Rome Termini (departure: Roma FIUMICINO – Arrival: Roma Termini) and from Rome TERMINI to Salerno (departure: Roma Termini – Arrival: Salerno) on the web site: http://www.trenitalia.com/en/index.html

Once in Salerno you can reach Vietri sul Mare by bus numbers 4 or 9, which depart every 20 minutes from 6:05 am to 22:45 pm (after 19:00 pm departures are reduced) from Salerno Railway Station Square.

2. If you are coming from Naples with a local train, your train ticket (UNICO) could be also used also for these busses. Get out of the bus at the stop in front of "Ceramica Solimene building". Crossing the street you will be in Vietri.

   To reach the hotel La Lucertola read the instructions at the end of this page. An alternative is to take a taxi (the cost is about €20) from Salerno Railway Station Square directly to your hotel

   To reach HOTEL LA LUCERTOLA from Vietri you must walk down to the Vietri Marina. You can take either Via Colombo or Via Pellegrino. Via Colombo is more comfortable if you want first reach the HOTEL La LUCERTOLA. Via Pellegrino should be preferred for those not booked at LUCERTOLA. Another possibility is to take a taxi (the cost is about 20,00 Euro) from Salerno Railway Station Square directly to your hotel

<u>To reach the venue at IIASS</u>

The IIASS centre (http://www.iiassvietri.it/informazioni.html) is located at Marina di Vietri sul Mare, and can be easily reached by walk (5 minutes) from Vietri.

<u>Participation:</u> Free. All participants are required to be present for the whole duration of the Training School.

<u>Student Grants:</u> The School is free and applications are welcome from far and wide. We intend a maximum of 40 participants with applications taken on a first come first served basis (on the basis of receipt of the application by email) until the 40th application is received. Applications including a brief statement of purpose and details of current professional affiliation and status should be sent to mark.elliott – at – nuigalway.ie carbon copies to argiro.vatakis – at - gmail.com and iiass.annaesp – at - tin.it with the subject title APPLICATION FOR TIMELY TRAINING SCHOOL SALERNO.

A limited number of 17 participants may be admitted to the Training School with support of 500 euros (travel and accommodation) from TIMELY. This support can only be provided for participants who attend the full training school *and* present a poster during the poster session. This poster can either focus on already conducted work, or on planned work.

This support is available to participants at any level although we particularly encourage applications from individuals at advanced Master, PhD or Post-Doc level. Applicants should submit the following documents both to argiro.vatakis – at - gmail.com and mark.elliott – at – nuigalway.ie with the subject title APPLICATION FOR SUPPORT: TIMELY TRAINING SCHOOL SALERNO

- Curriculum vitae
- Statement of purpose (max 1 page)
- Title and Abstract of the poster that will be presented in the student poster session
- A detailed budget for travel.

For full consideration, applications should be submitted *before* February the 15th. On February the 21st we will inform applicants to be funded, while any remaining funding will be assigned on a first-come, first served basis.

Credits: The Training School is kindly co - supported by International Institute for Advanced Scientific Studies (IIASS) Vietri sul Mare (IT).

Workshops will make use of a suite of 20 PCs with MATLAB 6.1 installed within the IIASS. No previous knowledge of Matlab is required although a basic working knowledge would be helpful.

For more information on the Training School or joining TIMELY: contact Argiro Vatakis at argiro.vatakis@gmail.com or visit www.timely-cost.eu.

DAY 1 – May 2nd, 2012

8:30	Registration
	Dynamical systems for psychological timing and timing in speech processing **Day 1**
9:30 – 10:30	Introductory Keynote By Lawrence Ward Time, noise, and rhythms in cognitive science
10:30-11:00	*Coffee Break*
11:00-13:00	Workshop 1: Recurrence Analysis and the EEG Stefan Schinkel and Kitty Moloney
13:00-14:30	*Lunch Break*
14:30-16:30	Workshop 2: Analysis of Interpersonal Dynamics in Spoken Interaction Anne S. Warlaumont and Rick Dale
16:30-17:00	*Coffee Break*
17:00-18:00	Keynote By Chris Kello Intrinsic dynamics of dyadic interaction
18:00-18:30	Participant Discussion

DAY 2 – May 3rd, 2012

	Dynamical systems for psychological timing and timing in speech processing **Day 2**
9:00-10:00	Keynote By Robert Port Metrically produced speech and the Japanese mora
10:00-10:30	*Coffee Break*
10:30-11:30	Keynote By Lawrence Ward Dynamics of reading in the brain
11:30 – 12:30	Keynote By Chris Kello Critical branching neural networks
12:30-13:00	Participant Discussion
13:00-14:30	*Lunch Break*
14:30-16:30	**Workshop 3:** Methods of Dynamical Brain Activity Analysis During Cognitive and Verbal Tasks Katarzyna J. Blinowska and Jarek Żygierewicz
16:30 -17:00	*Coffee Break*
17:00-19:00	*Poster Session*

DAY 3 – May 4th, 2012

	Dynamical systems for psychological timing and timing in speech processing **Day 3**
9:00-10:00	Keynote By Robert Port Why a language is a set of social conventions and not a knowledge structure
10:00-10:30	*Coffee Break*
10:30-12:30	**Workshop 4:** Analysis of the Action Dynamics of Choice Denis O'Hora, Petri Piiroinen and Rick Dale
12:30 – 13:00	Participant Discussion
13:00-14:30	*Lunch Break*
14:30-15:30	Summary Keynote By Cees van Leeuwen What is it like, for a brain to be a dynamical system?
15:30-16:30	Meeting close

Activities & Abstracts

Lawrence Ward
University of British Columbia, Canada
Talk 1: Time, noise, and rhythms in cognitive science

Abstract:
What is time? It is certainly fundamental to the dynamical approach to cognitive science but what is it, really? How do we conceptualize it so as to use it to inform our understanding of our world? Similarly, noise is ubiquitous and can sometimes be egregious (e.g., speech masking). But is it always bad? How do we describe noise? What role does it play in the brain? Finally, one important view of time is that it is generated by systemic oscillations. Many systems oscillate; they move from and return to a given state repeatedly. Pendula, hearts, atoms, and individual neurons, and brains all exhibit this phenomenon. We use these repeating cycles to measure time, but indeed they generate systemic time. Importantly, noise affects oscillations, sustaining them and modulating synchronization among systems of autonomous oscillators (e.g., neurons). The three fundamental concepts are inextricably intertwined and together provide many new ways to think about speech and language as well as other psychological processes.

References:
McDonnell & Ward (2011): The benefits of noise in neural systems: bridging theory and experiment. Nature Reviews Neuroscience, 12, 415425.
Ward (2002): Dynamical Cognitive Science. Cambridge. MA: MIT Press. Ward (2009) Physics of neural synchronisation mediated by stochastic resonance. Contemporary Physics, 50,563-574.

Talk 2: Dynamics of reading in the brain

Abstract:
The neural processes underlying letter and word reading are not yet completely understood. We studied the interplay between local and long distance neural dynamics involved at each stage of processing during reading using high density EEG. Readers viewed sequences of three letters followed by a three letter word, and responded as to whether or not they matched. Independent component analysis and dipole fitting yielded neural sources previously identified as crucial to word reading. Relative power, phase synchrony, and transfer entropy analyses performed on the independent components confirmed previously established paths of activation involved in reading text. A chain of local theta power increases preceding changes in phase synchrony and accompanied by increases in transfer entropy was found from early visual areas to the visual word form area, and from the latter to the right superior temporal gyrus, as well as to language processing areas such as Broca's and Wernicke's. Modulations of gamma power and phase synchrony within and between these regions was also found, particularly for word presentation. These results expand our knowledge of the dynamic brain processes underlying fluent reading and will serve as an example of how sophisticated dynamical approaches can illuminate language related psychological processes.

Background: Dehaene (2009): Reading in the Brain. New York: Penguin.

Recurrence Analysis and the EEG

Stefan Schinkel and Kitty Moloney
(Department of Physics, Humboldt University, Berlin, Germany; Department of Economics, NUI Galway, Ireland

Analysis of Interpersonal Dynamics in Spoken Interaction

Anne S. Warlaumont and Rick Dale
Communication Sciences and Disorders, University of Memphis and Cognitive and Information Sciences, University of California, Merced, USA; Cognitive and Information Sciences, University of California, Merced, USA

The aim of this workshop is to demonstrate how time series methods, such as recurrence analysis, can be applied to the dynamics of spoken interaction. We will show how analyses can reveal psychologically interesting patterns of timing between interlocutors. These patterns include the strength of coupling between two speakers, the leader-follower dynamics of conversation partners, and others. The workshop will span a range of timescales and applications, from language development to brief everyday interactions by adults, demonstrating the versatility of the approach. Attendees will learn how to obtain relevant data, and how to analyze these data sources in common programming environments.

Didactics

After a brief overview motivating the workshop, the instructors will each give examples from their own research on speech development in children and on adult conversation to illustrate the application of the methods. Slides, related papers, and scripts in MATLAB, R, Praat, and Perl for performing the analyses will be posted on the web for participants to download.

Anne Warlaumont's research includes the study of child-caregiver vocal interactions in daylong naturalistic recordings. She will showcase several analyses that can be carried out on spoken interaction during development. For example, overall level of interaction and general tendencies of the child to lead versus follow are obtained from cross-recurrence analysis. Other dynamic indices include the proportions of speech turns getting a response from the other speaker, and degrees of dependence between adult responses and child acoustics. It will be argued that the observed patterns of speech related vocal interaction dynamics support the theory that there is a positive feedback loop between child and caregiver that supports speech development and is damped in autism. A brief tutorial will walk the workshop participants through the steps (performed in MATLAB, Perl, Praat, and R) of text and acoustics processing followed by cross-recurrence and response contingency analysis.

Rick Dale's research program includes the study of face-to-face interactions between adults. Hewill provide examples of published research that showcase dynamics-inspired methods applied to spoken interactions. This will include a discussion of how to obtain relevant sources of data (e.g., video, audio, coded transcripts, etc.), how to format and import these data into common programming environments (e.g., MATLAB and R), and how to analyze these sources once imported. Analyses will focus on cross recurrence analysis, but he will also discuss related methods such as lag sequential analysis, analysis of the cross-correlation function, and relative phase and turn-taking analyses in speech. The timing of speech signals between people will be discussed as revealing their higher-level cognitive contexts, such as collaboration, conflict, and affiliation.

Expected Outcomes

The focus will be on practical analysis of obtained signals, and how to interpret the results for publication. Through the presentations and accompanying website materials, the workshop will equip the participants with a range of methods for analyzing dyadic interactions, such as naturalistic conversation. They will learn how the methods interrelate, how they can be applied to real data, and some strategies for theoretical interpretation.

Instructors' Related Publications

Dale, R., Warlaumont, A. S., & Richardson, D. C. (2011). Nominal cross recurrence as a generalized lag sequential analysis for behavioral streams. *International Journal of Bifurcation and Chaos*, 21(4), 1153-1161.

Richardson, D. C. & Dale, R. (2005). Looking to understand: The coupling between speakers' and listeners' eye movements and its relationship to discourse comprehension. *Cognitive Science*, 29, 39-54.

Richardson, D.C., Dale, R., & Kirkham, N. (2007). The art of conversation is coordination: common ground and the coupling of eye movements during dialogue. *Psychological Science*, 18, 407-413.

Warlaumont, A. S., & Jarmulowicz, L. (in press). Caregivers' suffix frequencies and suffix acquisition by language impaired, late talking, and typically developing children. *Journal of Child Language*.

Warlaumont, A. S., Oller, D. K., Dale, R., Richards, J. A., Gilkerson, J., & Xu, D. (August, 2010). Vocal interaction dynamics of children with and without autism. In S. Ohlsson & R. Catrambone (Eds.), *Proceedings of the 32nd Annual Conference of the Cognitive Science Society*. Austin, TX: Cognitive Science Society, 121-126.

Buder, E. H., Warlaumont, A. S., Oller, D. K., & Chorna, L. B. (May, 2010). Dynamic indicators of mother-infant prosodic and illocutionary coordination. In the *Proceedings of Speech Prosody* 2010.
Warlaumont, A. S., Oller, D. K., Buder, E. H., Dale, R., & Kozma, R. (2010). Data-driven automated acoustic analysis of human infant vocalizations using neural network tools. *Journal of the Acoustical Society of America*, 127(4), 2563-2577.

Chris Kello
University of California Merced, USA

Talk 1: Intrinsic dynamics of dyadic interaction

Abstract:
Many kinds of human dyadic interactions are characterized by turn-taking, as in games and sports like checkers and tennis, as well as less regulated interactions like dialogs and collaborations. Turn-taking often results in a tendency towards entrainment, broadly defined to mean a convergence in the timing and content of behavior. In these cases, the rhythmic consistency of turn-taking creates conditions for measuring the intrinsic dynamics of dyadic interaction, i.e. variations in behavioral measurements where effects from changes in stimuli, conditions, or experimental protocols are minimized. Experiments will be presented on intrinsic dynamics in spoken words produced by dyadic partners taking turns, and compared with similar experiments on spoken words repeated by individuals. Results provide evidence for theories of entrainment in dyadic interaction, as well as theories of intrinsic dynamics.

Talk 2: Critical branching neural networks

Abstract:
Timing in speech and behavior is supported by timing in neural activity. Action potentials (a.k.a. "spikes") are signals among neurons generally theorized as entirely temporal entities, i.e. individual points in time. Therefore timing in speech and behavior must be supported by spike timing, at some level of analysis. A spiking neural network model is presented that accounts for intrinsic dynamics in neural activity as well as behavioral activity. Model dynamics are inherently asynchronous and event-driven, which are key properties of its mechanics that allow it to account for temporal scaling laws found in studies of intrinsic dynamics. Applications of the model to other aspects of speech and behavior will be discussed.

Robert Port
Indiana University, Bloomington Indiana, USA

Talk 1: Metrically produced speech and the Japanese mora

Abstract:
People find it easy and natural to speak rhythmically. How are these periodic timing patterns produced? Exactly what are the events that are being timed? Could it really be, for example, Cs and Vs? And what kind of dynamical structure accounts for their regularity? Simple dynamical systems can provide insight into how speakers can achieve speech that sounds regular and periodic.

Talk 2: Why a language is a set of social conventions and not a knowledge structure.

Abstract:
The standard view is that words have a discrete representation in memory and that a small number of phonemes or feature vectors are manipulated by rule to produce articulatory specifications. But there is now a great deal of evidence that linguistic memory does not resemble what is postulated by formal phonological theories. Instead, speakers rely on richly detailed memory for words and specific utterances for creating their own linguistic performances. The regularities noted by linguists, such as the limited sets of vowels and consonants employed, the feature-like composition of phonemes and regularities like the `sentence' are conventions created by communities(acting as complex adaptive systems) over many generations. They do not indicate the existence of discrete linguistic components for word representation, no matter how strongly our intuitions support the phoneme-word-sentence model of language.

Methods of Dynamical Brain Activity Analysis During Cognitive and Verbal Tasks

Katarzyna J. Blinowska and Jarek Żygierewicz
Warsaw University, Poland

Background.
In the Department of Biomedical Physics of Warsaw University we have been concentrating on the development of the methods of brain signal analysis and in particular on the methods of time-frequency analysis. We have contributed one of the firsts papers on the application of the wavelet analysis to EEG (Bartnik et al.,1992) and first application of Matching Pursuit (MP) - the most advanced method of time-frequency analysis to the biological signal (Blinowska and Durka, 1994). The methodological ameliorations of the method was introduced (Durka et al., 2001) and many applications of MP method to EEG analysis followed (Durka and Blinowska, 2001). The time-frequency analysis of EEG signal was particularly fruitful in description of sleep EEG patterns (Malinowska et al., 2007) and in studies of event-related modulations of oscillatory activity in EEG (Żygierewicz et al., 2005). The method was applied as well to auditory evoked magnetic field (Żygierewicz et al., 2008)
For the evaluation of the interaction between brain structures Directed Transfer Function - DTF (Kaminski and Blinowska, 1991) was introduced and its time-varying version Short-time Directed Transfer Function was proposed (Kaminski et al., 2001, Ginter at al., 2001).
One of the first applications of SDTF was determination of the dynamic propagation during the performance of finger movement and its imagination (Kus et al.2006). Interestingly, in case of movement imagination the propagation from motor cortex started later and a cross-talk between different electrodes overlying motor area and supplementary motor area was observed.
SDTF appeared to be a valuable tool in the analysis of cognitive experiments (Blinowska et al.2010) and it helped to elucidate the functioning of working memory in transitive reasoning tasks (Brzezicka et al.2011). The results of motor experiments in the form of movies are presented at the website http://brain.fuw.edu.pl/~kjbli/DTF_MOV.html and the animations of propagation during CAT test are available at URL http://brain.fuw.edu.pl/~kjbli/CAT_MOV.html.
The Short-time direct Directed Transfer Function (SdDTF) ¾ combination of SDTF and dDTF ¾

was used in the analysis of ECoG activity during word repetition (Korzeniewska et al., 2008). To evaluate event-related changes in ECoG a new statistical methodology was developed and an estimator called ERC- event related causality was introduced. The transmission between brain structures involved in speech understanding and processing of the verbal information were found. In particular: in the first phase (listening) flows from the auditory associative cortex to moth/tongue motor cortex and in the second phase (repeating the word) propagation from Brocas area (responsible for speech) to mouth/tongue motor cortex.
The above mentioned methods and their applications are described in the book: Practical Biomedical Signal Analysis Using Matlab by K.J. Blinowska and J. Zygierewicz, which recently (2011) was published by CRC Press (see the cover in attachment). The review of the methods for estimation of the transmission between brain structures may be found in (Blinowska, 2011).

Aims
The aims are to teach the modern methods of: 1) time-frequency analysis and 2) multichannel methods of the evaluation of dynamical transmission.

Didactics - The plan of the workshop.
Time- frequency (t-f) methods (J. Zygierewicz) - 1 h

- Short introduction of classical t-f methods: Wigner-Ville distributions, spectrogram, wavelets
- Adaptive approximations by Matching Pursuit
- Comparison of the methods
- Applications, in particular analysis of event related synchronisation and esynchronisation evolution in time-frequency space.
- Time-frequency analysis of acoustic signals

Multichannel methods of evaluation of dynamical transmission between brain structures (K. Blinowska - 1h)

- Introduction of estimators based on Granger causality principle
- Time-varying estimators
- Comparison of bi-variate and multi-variate estimators
- Comparison of non-linear and linear estimators, influence of noise and volume conduction
- Practical considerations (estimation of significance, possible pitfalls)

Applications of time-varying estimators of transmission (K. J. Blinowska, A. Korzeniewska 1h)

- Cognitive experiments
- Experiments concerning verbal tasks

Expected outcomes
Critical presentation of current time varying methods of signal processing pointing out to their advantages and disadvantages and indicating possible pitfalls will be profitable for the students. The references will be given to the Matlab routines and software freely available on the Internet, which will make possible for students to readily apply presented methods.

References
Bartnik E.A., Blinowska K.J., Durka P.J. (1992) Single evoked potential reconstruction by means wavelet transform. Biol Cyb 67:175-181
Blinowska K.J., Durka P.J.. (1994) The application of wavelet transform and matching pursuit to the time varying EEG signals. In: Intelligent Engineering Systems through Artificial Neural Networks, 4:535-540. Eds.:C.H.Dagli,B.R.Fernandez. ASME Press, New York, (invited paper)

Blinowska KJ, Kuś R, Kamiński M, Janiszewska J (2010) Transmission of Brain Activity During Cognitive Task. Brain Topography, 23:205-213
Blinowska K.J., Żygierewicz J. (2011) Practical Biomedical Signal Analysis using MATLAB. Taylor&Francis
Blinowska K.J. (2011) Review of the methods of determination of directed connectivity from multichannel data. Medical & Biological Engineering & Computing, 49(5):521-529
Brzezicka A, Kamiński M, Kamiński J, Blinowska KJ. (2011) Information transfer during transitive reasoning task. Brain Topography 24(1): 1-8
Durka P.J., Blinowska K.J. (2001) A Unified Time-Frequency Parametrization of EEGs. IEEE Engineering in Medicine and Biology Magazine, Special Issue: EEG Analysis and Modelling for Detection and Classification of Neural Patterns, 20/5:47-53
Durka PJ, Ircha D, Blinowska KJ. (2001a) Stochastic time–frequency dictionaries for matching pursuit. IEEE Trans Signal Process, 49(3):507–10
Ginter J Jr, Blinowska K.J., Kaminski M, Durka P.J. (2001) Phase and amplitude analysis in time-frequency space-application to voluntary finger movement. J Neurosci Methods 110:113-124
Kamiński M, Blinowska K.J. (1991) A new method of the description of the information flow in brain structures. Biol Cybern. 65: 203-210
Kamiński M, Ding M, Truccolo W, Bressler S (2001) Evaluating causal relations in neural systems: Granger causality, directed transfer function and statistical assessment of significance. Biol Cybern. 85:145-157
Korzeniewska A, Crainiceanu C, Kuś R, Franaszczuk PJ, Crone NE (2008) Dynamics of event-related causality (ERC) in brain electrical activity. Hum Brain Mapp. 29:1170-1192
Malinowska U., Durka P. J., Żygierewicz J., Szelenberger W. and Wakarow A.(2007) Explicit parameterization of sleep EEG transients, Computers in Biology and Medicine, 37(4):534-541
Żygierewicz J., Durka P.J., Klekowicz H., Franaszczuk P.J., Crone N.E. (2005) Computationally efficient approaches to calculating significant ERD/ERS changes in the time-frequency plane Journal of Neuroscience Methods 145:267-276
Żygierewicz J., Sielużycki C., König R. and Durka P.J. (2008) Event-Related Desynchronization and Synchronization in MEG: Framework for Analysis and Illustrative Datasets Related to Discrimination of Frequency-Modulated Tones, Journal of Neuroscience Methods,Vol 168(1): 239-247

Analysis of the action dynamics of choice

Denis O'Hora Petri Piiroinen and Rick Dale
Psychology, National University of Ireland Galway, Ireland
Mathematics, Statistics and Applied Mathematics, National University of Ireland Galway, Ireland
Cognitive and Information Sciences, University of California, Merced, USA

Aims

The aim of this workshop is to enable participants to collect data on movement during choice responses and introduce methods of analysis of the dynamics of such intra-response movement. Ongoing movement provides an index of ongoing cognition and this workshop will provide the tools necessary for participants to begin gathering and analysing data on semi-continuous computer-mouse trajectories during computer–based experimental tasks By peering within the response, rather than focusing just on its end-point choicewe can begin to examine its dynamic characteristics and compare them to the fine-grained predictions presented by theoretical accounts of the time-course of mental activity. Participants will learn how to collect computer-mouse cursor movement data using a number of popular experiment-generation software packages and how to import and analyze these data.

Workshop Design

The workshop will begin with a brief conceptual overview. This introduction will incorporate a review of a number of relevant studies in the experimental literature and will also touch on concepts in nonlinear dynamics relevant to the analyses. The first hands-on section of the workshop will demonstrate how to collect computer-mouse cursor movement data using Mousetracker, a free software package (Freeman & Ambady, 2010). In addition, the instructors will demonstrate how to collect mouse movements using Psyscope X, Matlab's psychophysics toolbox and E-Prime so that participants can incorporate such measures into their own paradigms. The second section of the workshop will demonstrate how to import these data into matlab and R for analysis.

Instructors

Denis O'Hora's research includes the analysis of action dynamics during binary choices. Motivated by an interest in matching law, he has used mouse movements to investigate response strength prior to the choice response. He has used a variety of software packages to generate experimental paradigms and will lead this section of the workshop.

Rick Dale has published a number of studies on action dynamics during cognitive tasks. His work has demonstrated that action dynamics during responding are related to the probability of choosing a particular response option (McKinstry, Dale & Spivey, 2008) and that action dynamics provide robust indices of learning (Dale, Roche, Snyder & McCall, 2008). He has also written a number of influential reviews of the action dynamics literature. He will contribute to both sections of the workshop, but he will take the lead when discussing certain measures of response trajectories which he has developed.

Petri Piiroinen's work primarily concerns are nonlinear dynamical systems and how to interpret data in order to establish the structure and behaviour of the underlying system. With Denis O'Hora and Fionnuala Connolly, he has developed novel methods for the analysis of mouse trajectories of binary choice responses that allow us to visualise competing attractors in behavioural/cognitive space. He will demonstrate these methods for participants in the second section of the workshop.

Outcomes

This workshop is intended to provide participants with the conceptual understanding and practical tools to begin new lines of research that incorporate action dynamics and to include indices of action dynamics in their ongoing research work.

Relevant Publications

Dale, R., Roche, J. M., Snyder, K., & McCall, R. (2008). Exploring action dynamics as an index of paired-associate learning. PLoS ONE, 3, e1728. doi:10.1371/journal.pone.0001728

Freeman, J.B. & Ambady, N. (2010). MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method. Behavior Research Methods, 42, 226-241.

Freeman, J. B., Dale, R., & Farmer, T. A. (2011). Hand in motion reveals mind in motion. Frontiers in Cognition, 2, (59). doi:10.3389/fpsyg.2011.00059

Mason, J. and Piiroinen, P.T (2009). The effect of codimension-two bifurcations on the global dynamics in a gear model. SIAM Journal on Applied Dynamical Systems 8(4), 1694-1711.

McKinstry, C., Dale, R., & Spivey, M. J. (2008). Action dynamics reveal parallel competition in decision making. Psychological Science, 19, 22-24. doi:10.1111/j.1467-9280.2008.02041.x

Nordmark, A.B. and Piiroinen, P.T. (2009). Simulation and stability analysis of impacting systems with complete chattering. Nonlinear Dynamics 58(1), 85-106.

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What is it like, for a brain to be a dynamical system?

Abstract:
Taking a dynamical stance towards the brain means emphasizing the temporal structure of brain activity. When we do so, we readily observe the hallmark 1/f phenomenon of complexity, also known as long-term dependency, in its dynamic activity patterns. Such results are both revolutionary and yawn-inspiring at the same time. They are revolutionary in showing the insufficiency of approaching the brain as a linear system. They inspire yawns because we knew this all along. Complexity is pervasive in nature, so in order to gain ground after the initial awe has waned, we need a more explicit and detailed characterization of brain dynamics. This means we need to move from data-driven explorations of brain activity to testing of dynamical models. These models may early on be simple and qualitative in their predictions, but ultimately have to be detailed and quantitative characterizations. In developing these models, certain principles will come to the fore. What might these principles be, and what instruments will we need to get there?

Student Abstracts

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