



accenture



LATVIJAS  
UNIVERSITĀTE  
ANNO 1919

Datorikas  
fakultāte

Laboratory for Perceptual and Cognitive Systems  
at Faculty of Computing, University of Latvia

## *Topology, geometry, and function*

### **Workshop / Seminar**

### **on topology and geometry of information visualisation**

Laboratory for Perceptual and Cognitive Systems, Faculty of Computing,  
University of Latvia, Riga, Latvia

19 Raina boulev., Riga, Latvia, <https://www.lpcs.lu.lv/upcoming-events/>

#### PROGRAM

## June 1

10 00 – 10 30 Registration + Coffee

Room 12

10 30 Welcome

10 35 – 11 00 Presentation of Lab's Project „Topological Modelling of Structural Alignment: A Topological and Experimental Analysis of Information Visualisation”.

11 00 – 12 15

Keynote:

Prof. Kenny Coventry

FBPS, FRSA, Head of the School of Psychology, University of East Anglia, UK

The psychological science of visual information: How to engage an audience in a multimedia world.

12 20 – 13 05

Prof. Christian Freksa

Bremen Spatial Cognition Center, University of Bremen, Germany

Geometric reasoning about distances and angles with strings and pins.

Lunch\*

13 05 – 14 30

14 30 - 15 00

Krista Pētersone

Faculty of Geography and Earth Sciences & Laboratory for Perceptual and Cognitive Systems, Faculty of Computing, University of Latvia

Access to the spatial archives of property: What do boundaries show?

15 00 – 15 30

Jurģis Šķilters, Līga Zariņa, Gurjit Theara, & Juris Borzovs

Laboratory for Perceptual and Cognitive Systems, Faculty of Computing, University of Latvia

Visuo-spatial cognition and learning: Cautious correlations and tentative impacts.

15 30 – 16 00

Līga Zariņa & Jurģis Šķilters

Laboratory for Perceptual and Cognitive Systems, Faculty of Computing, University of Latvia

Symmetry, geometry, and topology: Constraints of symmetry in form perception.

16 00 – 16 45

Olga Matrosova

Faculty of Humanities, University of Latvia

Is the cat really in the tree? The way adults perceive basic locatives in the second language.

16 45- 17 15 Coffee and discussion

Room 13

17 30-18 30

Keynote and *Accenture MadScience Talk*

Prof. Cees Van Leeuwen

Perceptual Dynamics Lab, University of Leuven, Belgium

Brain Unity and Brain activity duality

# June 2

Museum hall 415.

9.45 Coffee

10 00 – 11 15

Keynote:

Prof. Cees van Leeuwen

Perceptual Dynamics Lab, University of Leuven, Belgium

Dot lattices and brain dynamics

11 15 – 12 00

Dr. Stephen Lucek

University College Dublin, Ireland

Force-Dynamic and Geometry-based Prepositions in the Real World: The case for gathering spontaneous wayfinding and storytelling data

12 00 – 12 45

Eglė Žilinskaitė-Šinkūnienė

Department of Baltic Studies, Vilnius University, Lithuania

Jurģis Šķilters, & Līga Zariņa

Laboratory for Perceptual and Cognitive Systems, Faculty of Computing, University of Latvia

Topology and geometry in Baltic: where is the dark circle?

Lunch\*

12 45 – 13 30

13 30- 14 30

Closing Keynote:

Prof. Kenny Coventry

FBPS, FRSA, Head of the School of Psychology, University of East Anglia, UK

What, where and how in spatial language. Where are we now?

14 30 Closing + Coffee

15 00 Social Event (for registered participants only): National Museum of Art

(NB: please sign up during registration)

\* Lunches are not included in participation.



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This is the closing event of Lab's project „Topological Modelling of Structural Alignment: A Topological and Experimental Analysis of Information Visualisation”  
The project is supported by University of Latvia Donor SIA "Mikrotikls". Foundation of the University of Latvia is administrator of this donation.

# Abstracts (Keynotes)

## **The psychological science of visual information: How to engage an audience in a multimedia world**

Professor Kenny R. Coventry  
FBPS, FRSA, Head of the School of Psychology  
University of East Anglia, United Kingdom

People process only a small amount of the visual information in front of their eyes at any given moment in time. In this talk I review what recent psychological science research can tell us about how people perceive visual information in a multimodal context, synthesising key findings to consider how one can present information in a fashion that people find easiest to process, providing a more enjoyable and meaningful experience for them. I will use examples from recent projects at the University of East Anglia examining how to present climate change visual information in an accessible way (Harold, Lorenzoni, Shipley & Coventry, 2016), how gesture can be used to support visual processing (e.g. Coventry, Griffiths & Hamilton, 2014), and how emotion and position on screens become concatenated to influence ease of emotional engagement (Lynott & Coventry, 2014).

*ACCENTURE MadScience Talk*

## **Brain Unity and Brain activity duality**

Professor Cees van Leeuwen  
Perceptual Dynamics Lab  
University of Leuven, Belgium

Neuroimaging has thrown a bridge across the explanatory gap between brain and cognition. Or so it seems. Unfortunately a new gap has opened up, since the constructs of neuronal and regional “brain activity” play incompatible explanatory roles. This problem could be remedied by adopting a principle that applies to activity across scales. As such, I propose the principle of particle wave duality. Rather than for a static framework of neurons, circuits and brain regions, the duality exists for the entities that travel through them. At neuronal level, action potentials are the particles; the wave-field guiding their propagation consists of subthreshold potential fluctuations. At circuit level, packets of spatiotemporally coherent action potentials form the particles; their propagation is guided by their own wave field, consisting of weak modulations of spiking activity resulting from local population activity. At macrolevel, particles are precisely timed spiking activity propagating in coordinated fashion across pools of pyramidal neurons; their guiding waves are the product of their own synaptic activity. At all levels, these processes universally contribute to dynamically shaping an evolving architecture of complex networks and topographical maps, which in turn supports the flow of activity. At the largest scale, these patterns lead to the functional differentiation of conscious and unconscious processes.

## **Dot lattices and brain dynamics**

Professor Cees van Leeuwen  
Perceptual Dynamics Lab  
University of Leuven, Belgium

Michael Kubovy's work on ambiguous dot lattices has shown that perceptual grouping preferences depend quantitatively on proximity. Our EEG studies reveal that proximity grouping is a multi-stage process, irreducible to a single mechanism localized anatomically or chronometrically. Proximity sensitivity correlated positively with amplitude of the earliest ERP peak, C1, reflecting early feed-forward processes, and negatively with the next peak, P1, reflecting lateral and feedback interactions. This peak involved beta band synchronization, related to proximity sensitivity and inversely related to stimulus ambiguity. Pre-stimulus activity showed alternating modes of low and high alpha power. In the former mode, responses were biased towards the vertical orientation, irrespective of proximity; in the latter proximity-based responses were dominant. Biased responses, and their association with alpha power, vanished over the course of the experiment.

## **What, where and how in spatial language. Where are we now?**

Professor Kenny R. Coventry  
FBPS, FRSA, Head of the School of Psychology  
University of East Anglia, United Kingdom

Originally Landau and Jackendoff's (1993) argued that spatial language maps onto the "where" visual system, with object properties regarded as largely irrelevant for spatial language use. Since then it has become clear that spatial language comprehension and production involves a combination of "what", "where" and (more recently) "how" information underpinning their situation specific use. Building on the "functional geometric framework" proposed to underpin spatial language comprehension and production (Coventry & Garrod, 2004), I present an update on this framework considering spatial adpositions and demonstratives across languages. In doing so, I will address the longstanding debate regarding semantic universals in spatial language versus cross-linguistic variability and cultural relativism.

