Advanced Artificial Intelligence Technologies and Applications

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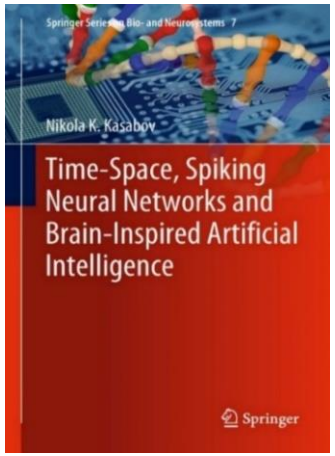
Advanced Artificial Intelligence Technologies and Applications

1. AI and the evolution of its principles. Evolving processes in Time and Space (Ch1, 3-19)
2. From Data and Information to Knowledge. Fuzzy logic. (Ch1,19-33 + extra reading)
3. Artificial neural networks - fundamentals. (Ch2, 39-48). Computational modelling with NN. Tut1: NeuCom.
4. Deep neural networks (Ch.2, 48-50 + extra reading).
5. Evolving connectionist systems (ECOS) (Ch2, 52-78). Tutorial 2: ECOS in NeuCom.
6. Deep learning and deep knowledge representation in the human brain (Ch3)
7. Spiking neural networks (Ch4). Evolving spiking neural networks (Ch5)
8. Brain-inspired SNN. NeuCube. (Ch.6). Tutorial 3: NeuCube software (IA)
9. From von Neuman Machines to Neuromorphic Platforms (Ch20 , 22)
10. Other neurocomputers: Transformers.
11. Evolutionary and quantum inspired computation (Ch.7)
12. AI applications for brain data: EEG, fMRI (Ch.8-11)
13. Brain-computer interfaces (BCI) (Ch.14)
14. AI applications for audio-visual information (Ch.12,13). AI for language modelling.
15. AI in bioinformatics and neuroinformatics (Ch15,16, 17,18)
16. AI applications for multisensory environmental data (Ch19).
17. AI in finance and economics (Ch19)



Course book: N.Kasabov, Time-Space, Spiking Neural Networks and Brain-Inspired Artificial Intelligence Springer, 2019, https://www.springer.com/gp/book/9783662577134

Additional materials: https://www.knowledgeengineering.ai/china

ZOOM link for all lectures: https://us05web.zoom.us/j/4658730662?pwd=eFN0eHRCN3o4K0FaZ0lqQmN1UUgydz09

Lecture 14. AI applications for audio-visual information (Ch.12,13). AI for language modelling.

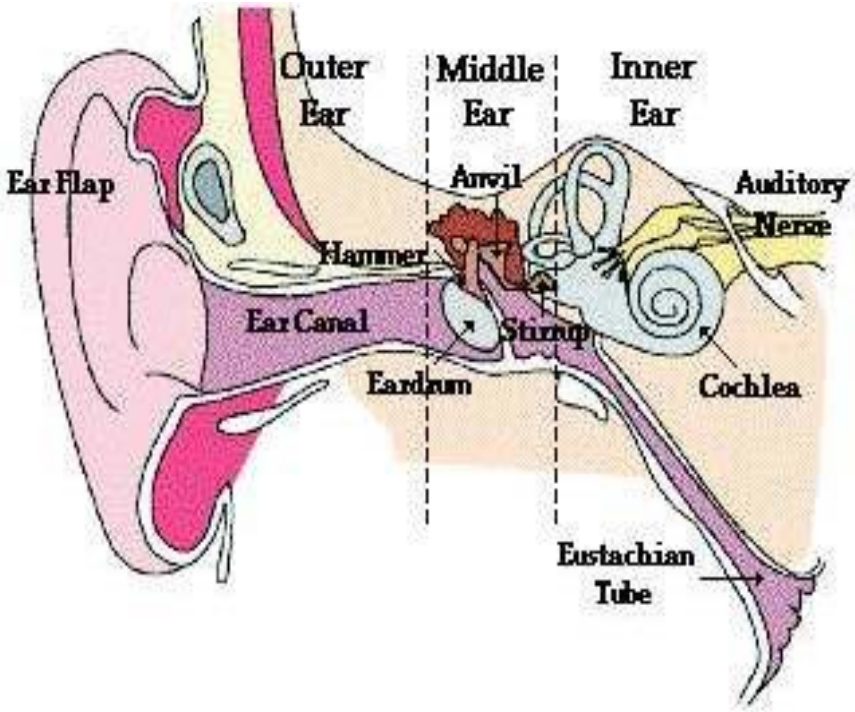
1. Audio and visual information processing in the human brain and its modelling in using evolving SNN (eSNN) (chapter 12)

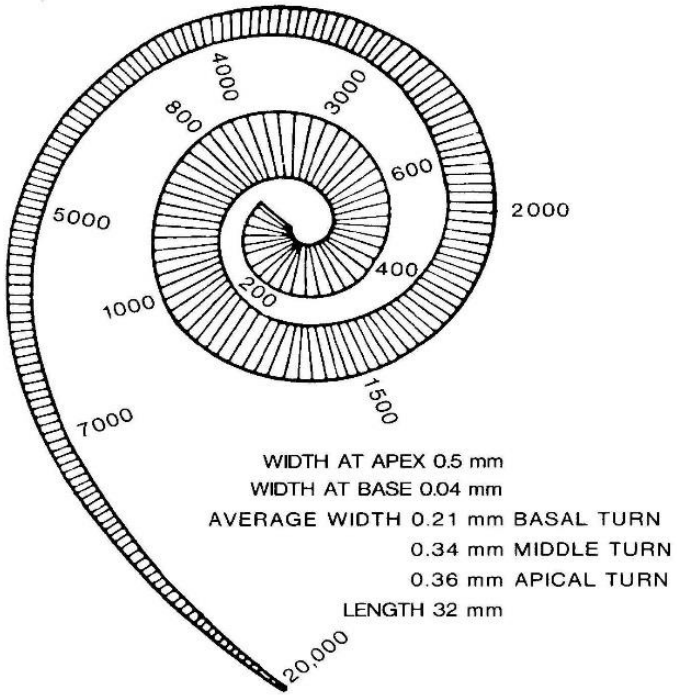
2. Deep learning and modelling of audio and visual and multimodal audio-visual data in BI-SNN (Chapter 13)

3. Language modelling in deep NN (extra reading)
4. Questions

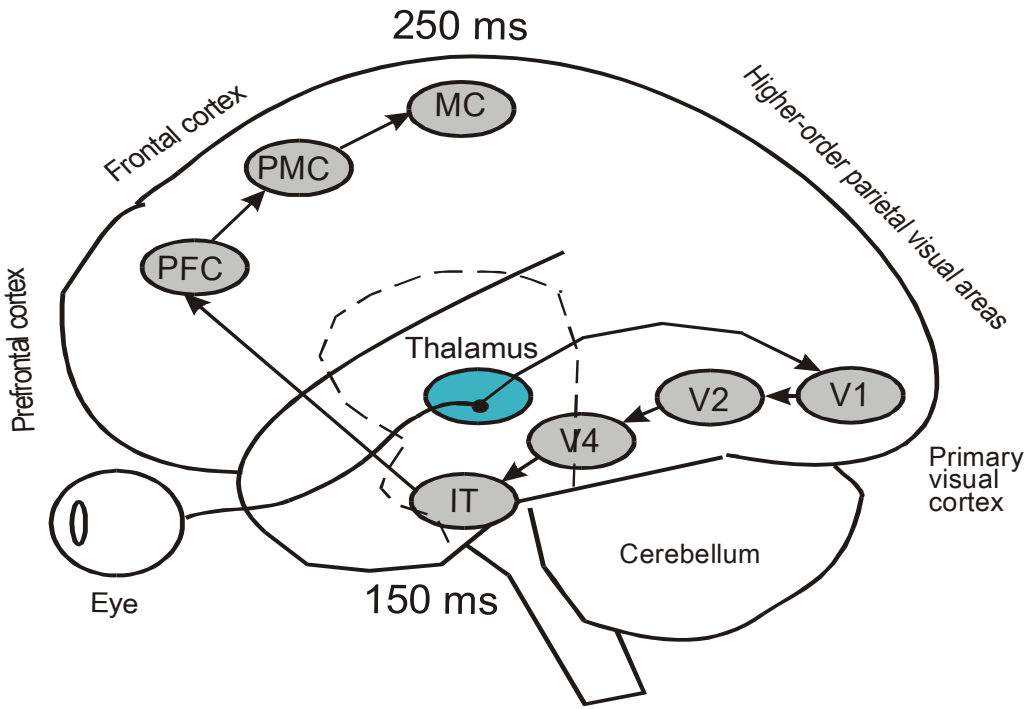
1. Audio and visual information processing in the human brain and its modelling in eSNN (Chapter 12)

Perceiving sounds in the human brain





Perceiving images in the human brain

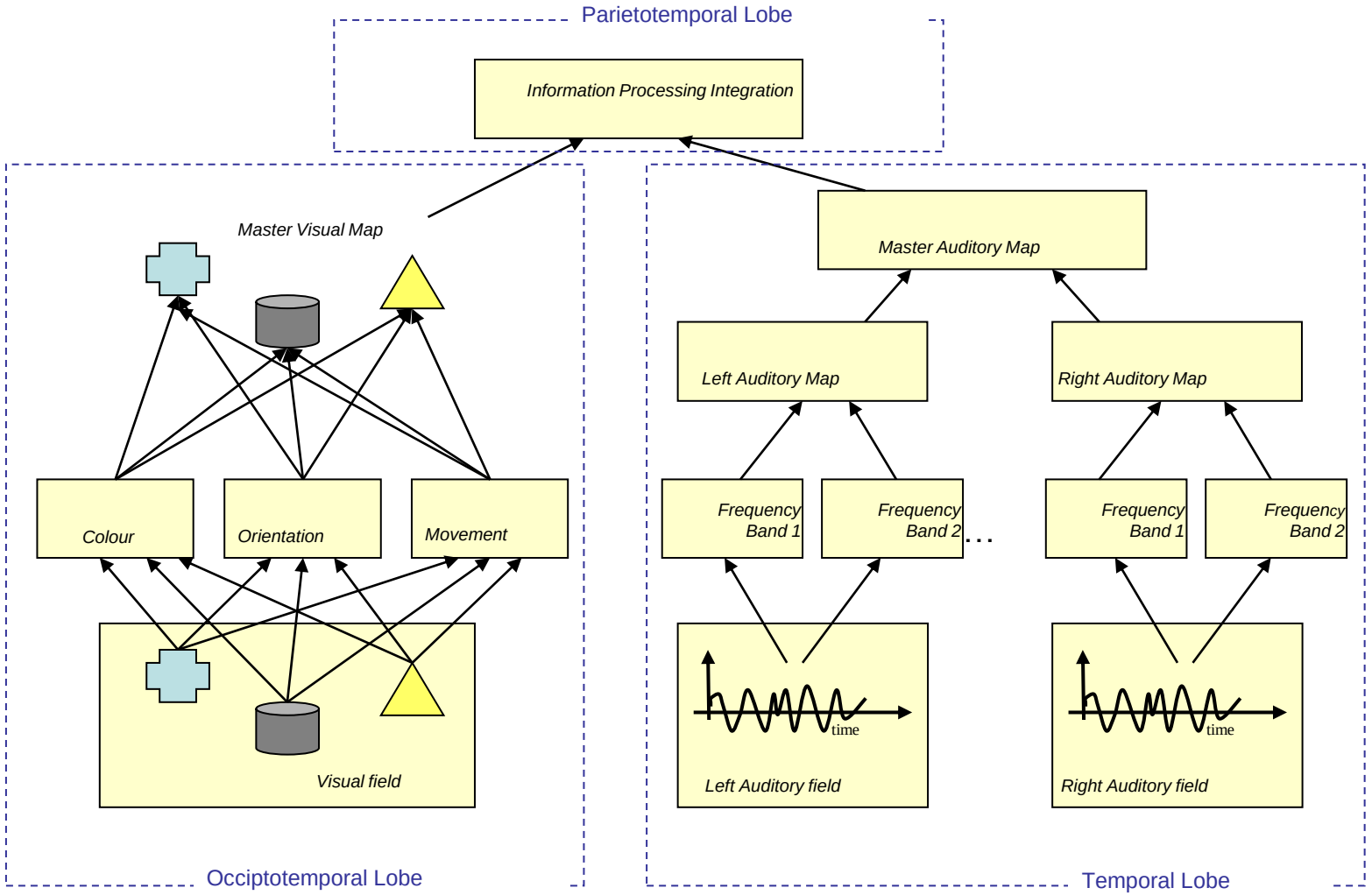


Deep serial processing of visual stimuli in humans for image classification and action.

Location of cortical areas: V1 = primary visual cortex, V2 = secondary visual cortex, V4 = quartiary visual cortex, IT = inferotemporal cortex, PFC = prefrontal cortex, PMC = premotor cortex, MC = motor cortex.

L.Benuskova, N.Kasabov, Computational neurogenetic modelling, Springer, 2007

Integrated audio-visual information processing in the human brain

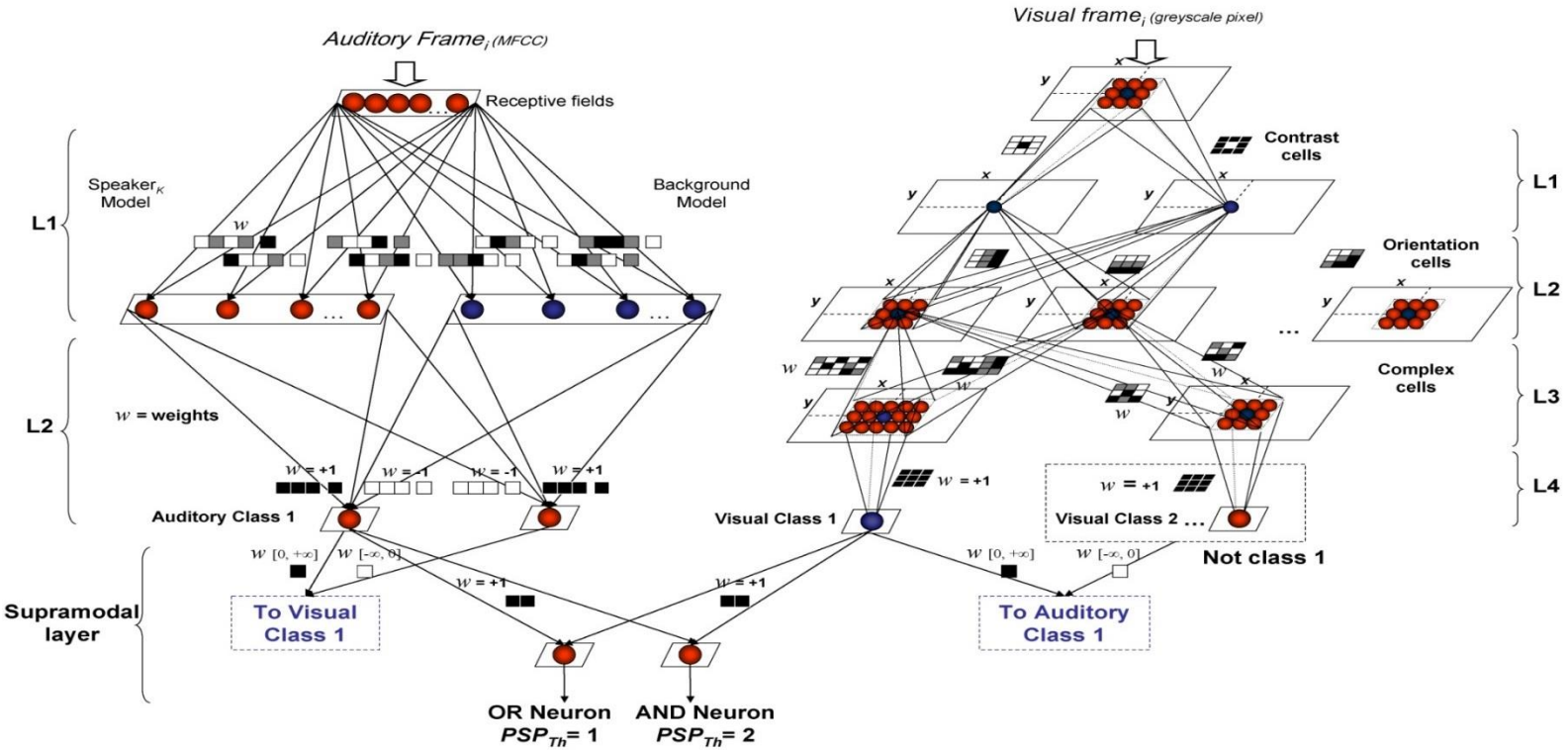


Audio- and visual information processing modelling with eSNN

-Convolutional layers

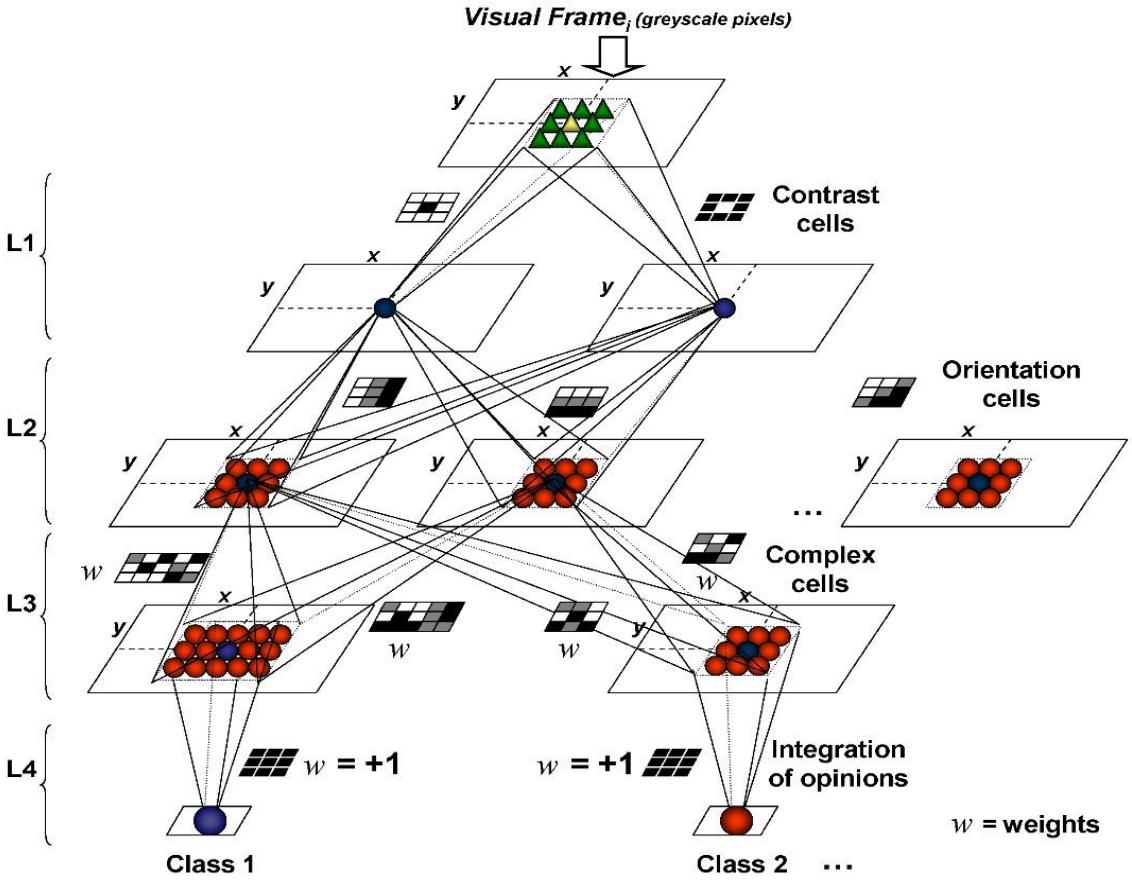
- Accumulation of spikes over time in the membrane potential

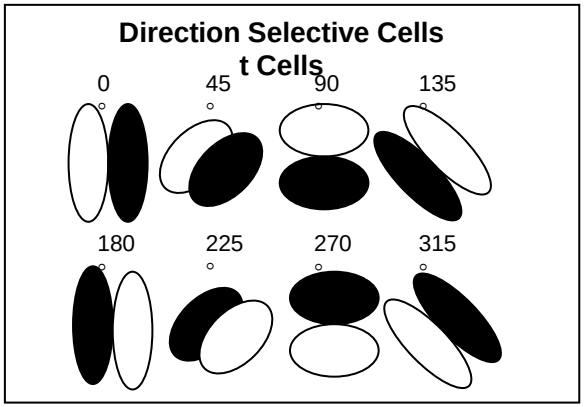
- Person authentication based on speech and face data



(Wysoski, S., L.Benuskova, N.Kasabov, Evolving Spiking Neural Networks for Audio-Visual Information Processing, Neural Networks, 23, 7, 819-835, 2013).

Image Processing using CSNN and Gabor filters.

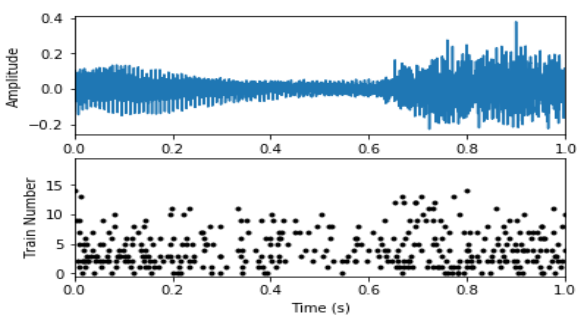


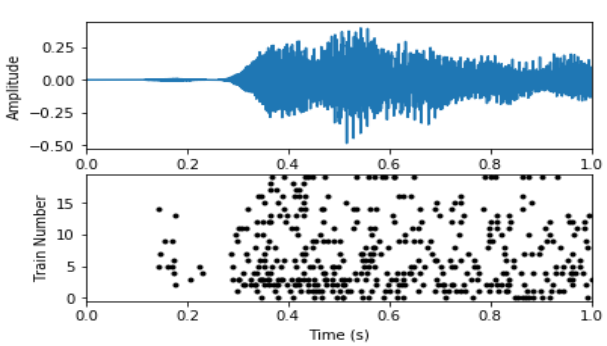


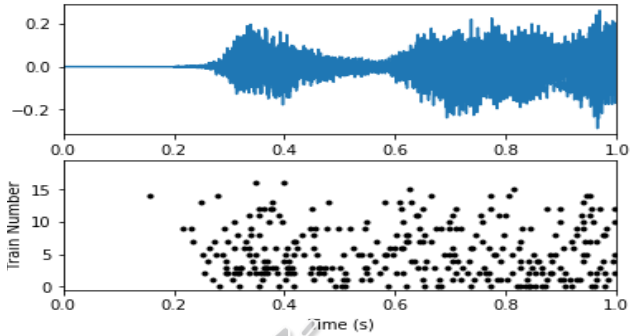
(Wysoski, S., L.Benuskova, N.Kasabov, Evolving Spiking Neural Networks for Audio-Visual Information Processing, Neural Networks, 23, 7, 819-835, 2013).

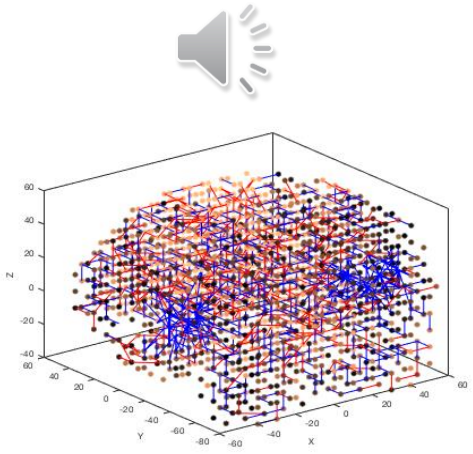
2. **Deep learning and modelling of audio and visual and multimodal audio-visual data in BI-SNN (Chapter 13)**

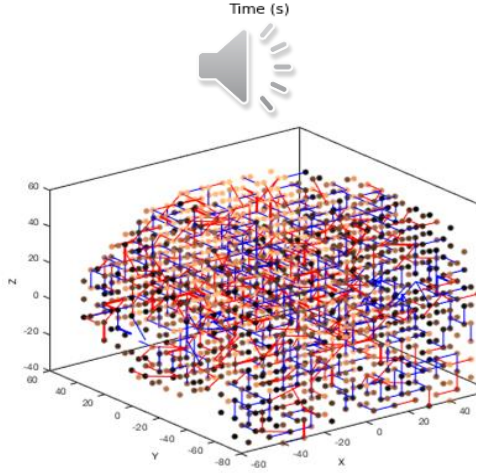
Using tonotopic, *stereo* mapping of sound and deep learning in NeuCube

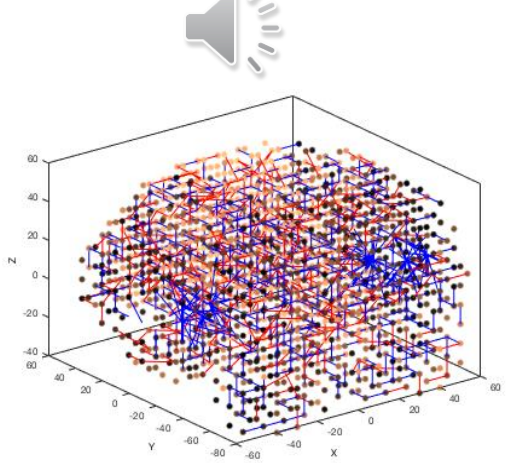






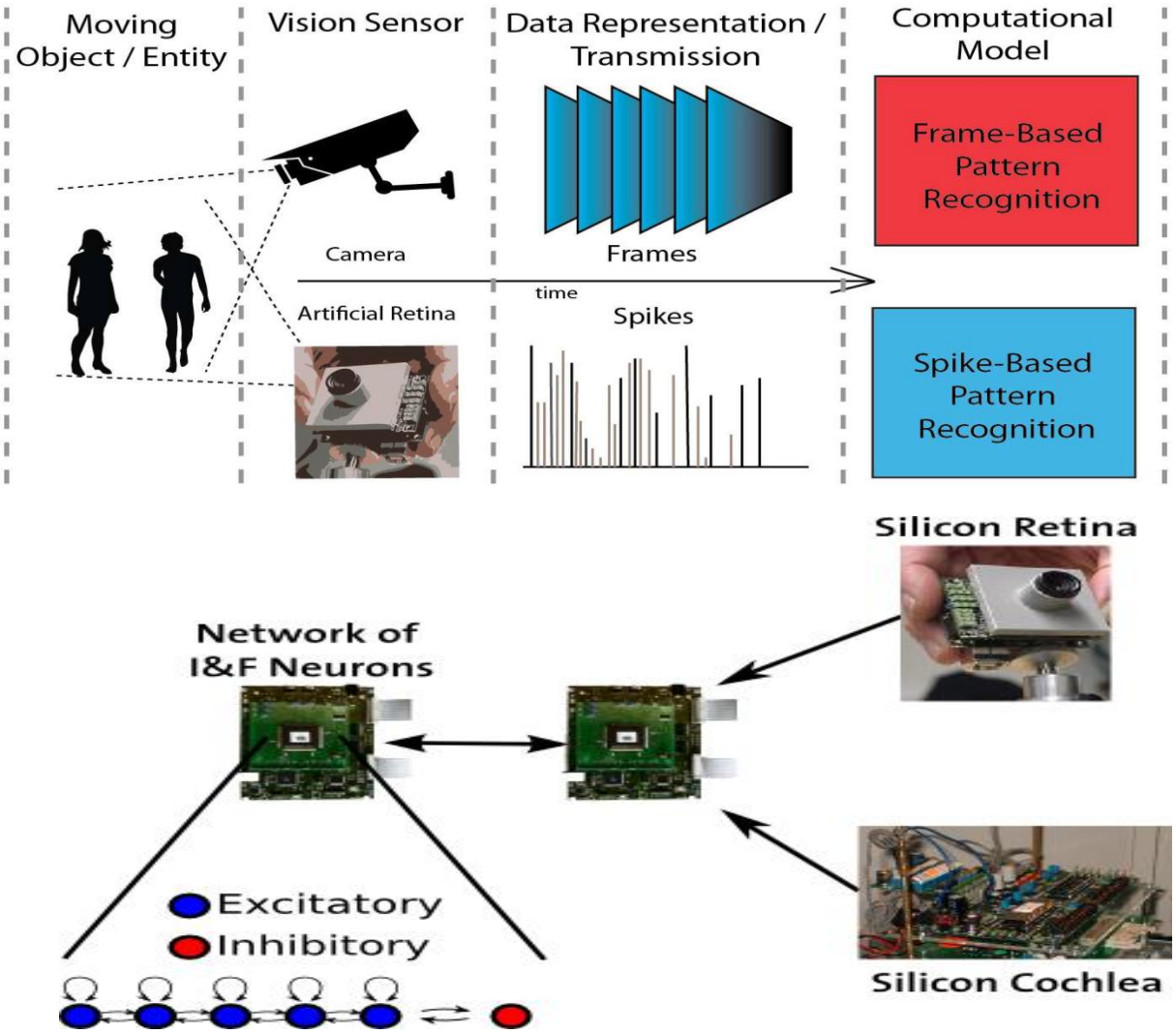






	Mozart	Bach	Vivaldi
Predicted 1	171	3	1
Predicted 2	9	176	1
Predicted 3	0	1	178

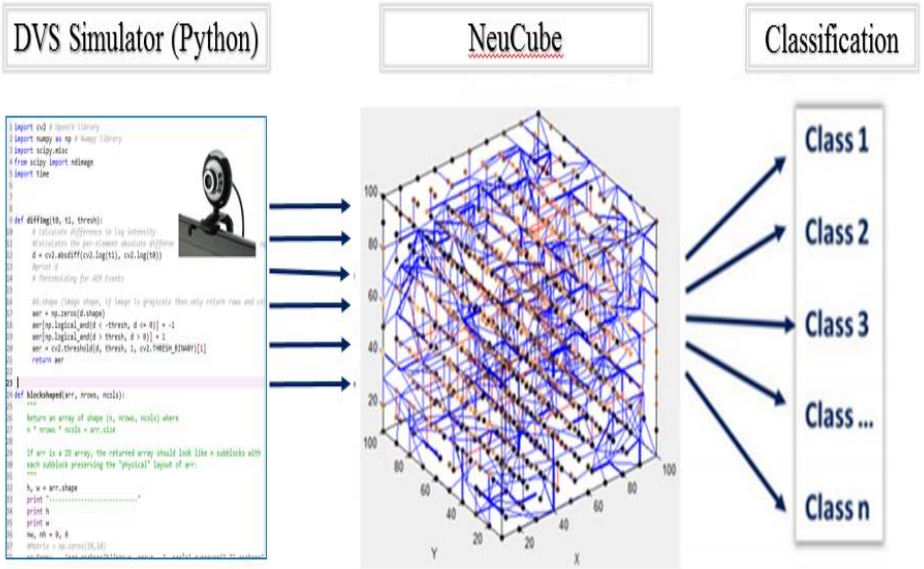
Deep learning of visual information



BI-SNN for fast object recognition from video streaming data

Applications:

- Surveillance systems
- Cybersecurity
- Military applications
- Autonomous vehicles



Overall Accuracy: 90.00%

-Class 1 Accuracy: 100.00%

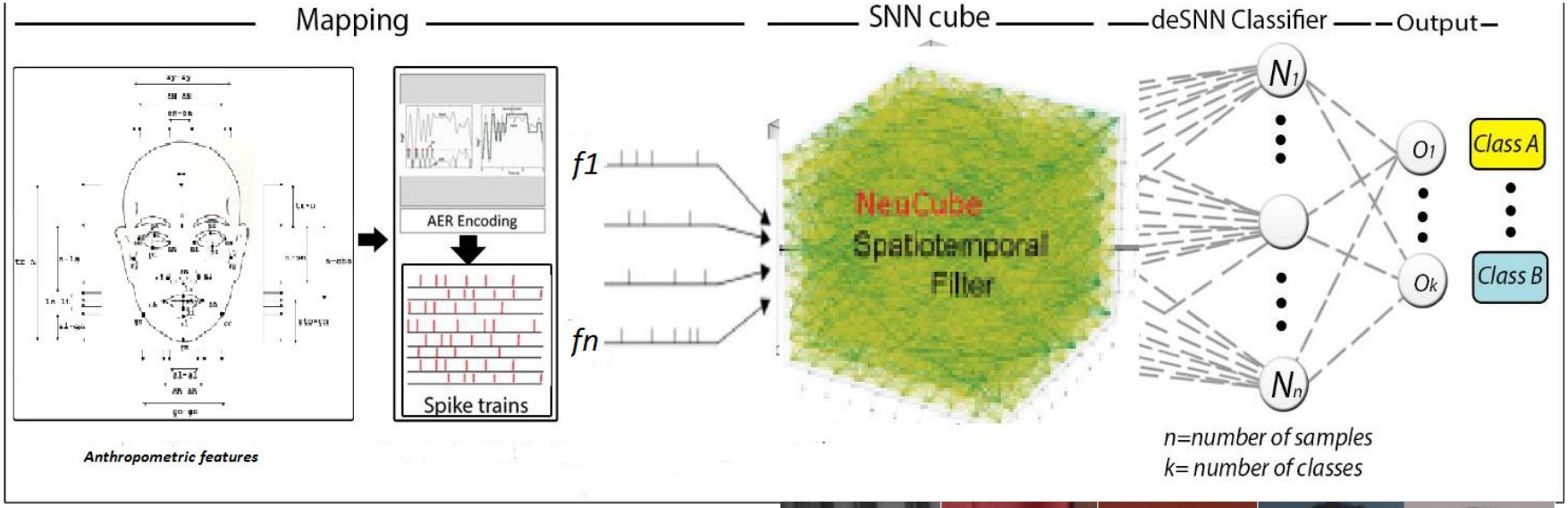
-Class 2 Accuracy: 100.00%

-Class 3 Accuracy: 80.00%

-Class 4 Accuracy: 80.00%

BI-SNN for gender and age group classification. Person verification.

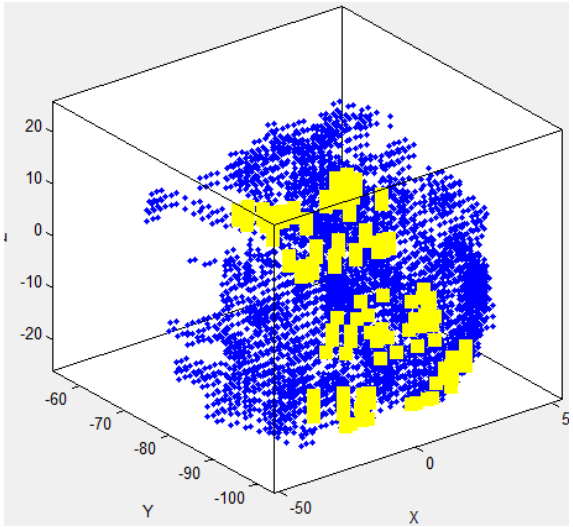
F. B. Alvi, R. Pears, N. Kasabov An evolving spatio-temporal approach for gender and age group classification with Spiking Neural Networks, Evolving Systems, Springer, 2017.



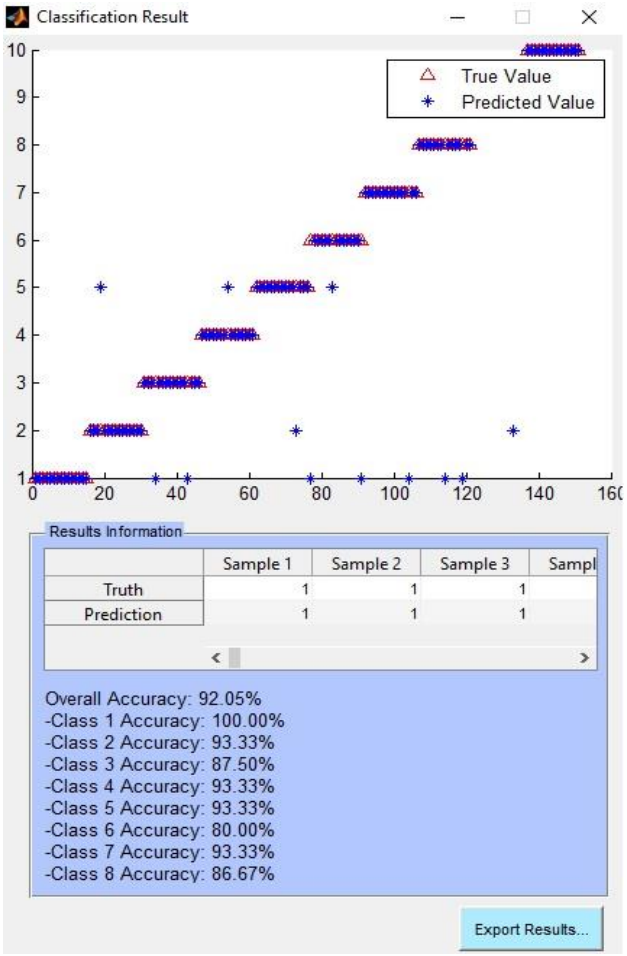
nkasabov@aut.ac.nz www.kedri.aut.ac.nz/neucube/

Deep learning and knowledge representation of moving objects using DVS and retinotopic mapping in NeuCube

30000 moving digits in 8 fonts and sizes from DVS MNIST



NeuCube with 4262 neurons from V1 and V2



L.Paulin, A.Abbott, N.Kasabov, A retinotopic spiking neural network system for accurate recognition of moving objects using NeuCube and dynamic vision sensors, Frontiers of Comp. Neuroscience, 2018, doi:10.3389/fncom.2018.00042.

3. **Language modelling in deep NN. ChatBots**

- - Open AI, ChatGPT

-AliBaba (China)

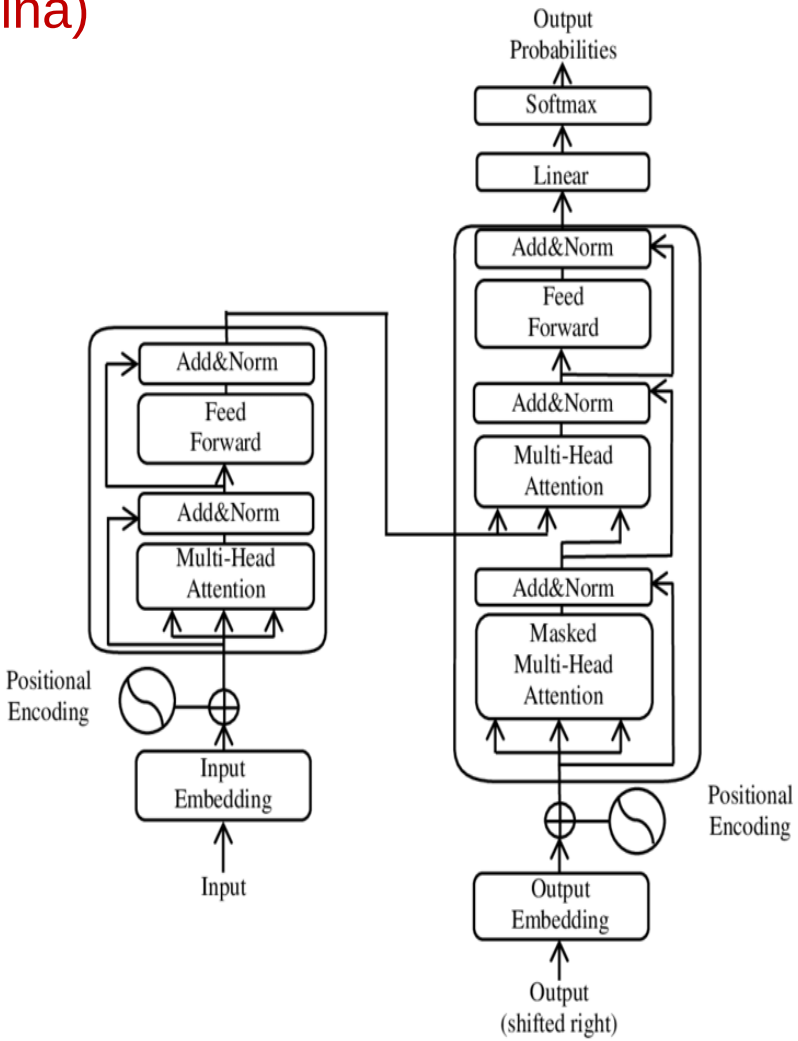
- other

Transformers are designed to process sequential input data, such as natural language, with applications towards tasks such as translation and text summarization.

Transformers process the entire input all at once. The attention mechanism provides context for any position in the input sequence.

Transformers allow training on larger datasets. This led to the development of pretrained systems such as GPT (Generative Pre-trained Transformer), which were trained with large language datasets, such as the Wikipedia Corpus and Common Crawl, and can be fine-tuned for specific tasks.

Transformers are NOT suitable for explanation of the solution or for on-line adaptation of new data. They are not suitable for spatio-temporal data either.



Questions

1. How is sound perceived in the human brain?

2. How are images perceived in the human brain?

3. How can we model integrated auditory-visual information processing?

4. How language models be created with deep NN?

5. Whatdo you know about ChatBots?