Real-time gesture recognition with new-generation smart materials

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Proposers:

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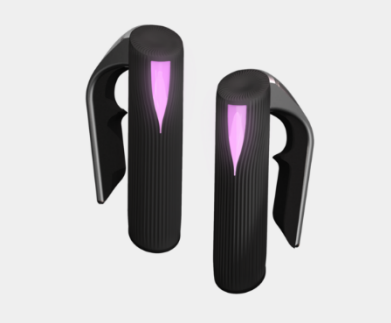
Background

Smart materials with gesture recognition capabilities are arguably amongst most promising enabling technologies of the future. Imagine living in environment which can understand your needs by sensing a particular stroke pattern or a gentle gesture. Imagine smart gloves or smart suits that can read your commands encoded by sequences of minute movements of your fingers or limbs and sending these commands to an appropriate device. Advanced smart homes technologies, intelligent hospitals, novel ways and better care for disabled people, and empowering people with capabilities which have previously been subject of sci fi movies – all these are inherent parts of the new reality where materials and objects can communicate with their human owners via multiple modalities, including speech, gestures, and touch.

Specific problem

In this problem, jointly proposed by the University of Leicester and Tangi0 Ltd, UK, students will be asked to develop and implement their own gesture recognition algorithms using a newly-patented Etee device manufactured and produced by Tangi0 Ltd (https://eteexr.com/collections/etee-controllers).



The device (pictured on the left) is a patented finger-sensing technology enabling gamers and enterprise users to control electronic interactions via the power of touch and pressure. Instead of traditional controllers with mechanical buttons the device features a smart control surface reacting to brush and touch. The task is to develop a machine learning model capable of reliably recognise a set of user-defined gestures using the new controller.

Depending on COVID-19 travel guidance and rules regulating face-to-face teaching, the students will either be provided with prototypes of the physical device to generate their own datasets, build and validate the model or, they will be provided with an access to relevant datasets prepared and collected by Tangi0 and University of Leicester.

Approach and work plan

On the first day, participating students will be provided with a tailored tutorial on relevant computational and mathematical background, including appropriate introduction into Statistical Learning Theory and guidance on data collection, analysis, and processing. During remaining days of the Modelling Week students will be provided with an opportunity to conduct supervised research and development programme with a view to build robust Deep Learning gesture recognition algorithms. In the process of solving this task the students will obtain first-hand experience in developing a functional data-driven Deep Learning system build on real data collected from a physical device. They will also acquire practical data mining and data analysis skills and will experiment with measure concentration effects in high dimensions to better understand robustness and stability of modern AI systems. Basic knowledge of MATLAB would be beneficial.

Recommended Literature

[1] R. O. Duda, G. Stork, P. E. Hart. Pattern classification and scene analysis, Wiley, 2000.
[2] V. Vapnik. The Nature of Statistical Learning Theory, Springer, 2000.
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[4] I.Y. Tyukin, A.N. Gorban, A.A. McEwan, S. Meshkinfamfard, L. Tang. Blessing of dimensionality at the edge and geometry of few-shot learning. Information Sciences, 564, pp.124-143, 2021
[5] I.Y. Tyukin, A.N. Gorban, M.H. Alkhudaydi,Q. Zhou. Demystification of Few-shot and One-shot Learning, 2021. arXiv preprint arXiv:2104.12174. (to appear in IEEE IJCNN 2021)