Final Year Project: Plan and Strategies
Title: Machine-learning Approach for Robot Tactile Representation and Perception
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Background

The heterogeneous tactile data from many kinds of sensors can provide information like temperature, hardness and smoothness of contact surfaces. Analyzing such data enables robots to "touch" and "feel" the surrounding environment. Previously studies have used spatial neural network (SNN), support vector machine [1] and convolution neural network (CNN) along with long short-term memory block [2] to classify data from two tactile sensors performing a touch sequence on more than 20 materials. As the data is generated by lateral sliding, it needs time to execute and contains both spatial and temporal features. Although SNN and CNN have achieved good results on these datasets, the models proposed are complex and hard to implement. Recently, a video transformer network build by Facebook applies both spatial backbone and temporal attention block to video recognition. This new structure can deal with data containing both spatial and temporal information, which is suitable for our dataset. Moreover, the simple structure and parallelable characteristic of transformer enable it to train much faster and still get comparable or even better results. Therefore, applying transformer network combined with spatial network shows a promising future for this task. In this project, a video transformer-based network will be implemented and explored. The performance of the designed transformer model will be evaluated and compared to previous results.

Project tasks and expected schedules

Tasks	Schedule
Read tactile analysis methods and understand tactile dataset	Wk1-3
Understand the concept of Transformer	Wk4-5
Study the model and code of Transformer	Wk6-7
Apply the model to tactile dataset	Wk8-9
Research and try different ways to improve model	Wk10-11
Learn about KUKA and tactile sensors Collect more tactile data	Wk12-13
Apply new data to the model	Wk1-3 2022
Final implementation	Wk4-6 2022
Fine-tune and wrap-up the model	Wk7-10 2022

Reference

[1] Gao, R., Taunyazov, T., Lin, Z. and Wu, Y., 2021. *Supervised Autoencoder Joint Learning on Heterogeneous Tactile Sensory Data: Improving Material Classification Performance*. [online] Ieeexplore.ieee.org. Available at: <https://ieeexplore.ieee.org/document/9341111> [Accessed 9 September 2021].

[2] Taunyazov, T., Chua, Y., Gao, R., Soh, H. and Wu, Y., 2021. *Fast Texture Classification Using Tactile Neural Coding and Spiking Neural Network*. [online] Ieeexplore.ieee.org. Available at: <https://ieeexplore.ieee.org/document/9340693/> [Accessed 9 September 2021].