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Active learning for medical imaging using Fisher information

Active learning aims at selecting training data in a way such that the robustness of the trained net is maximized and/or the required number of training data is kept at a minimum. Active learning is a current line of research in deep learning (see [1-3]) and relevant in cases where labeling is expensive or time consuming. This applies particularly to medical applications, where human experts are needed. State-of-the-art approaches are based on minimizing predictive uncertainty [2] or optimal exploration of feature space [3].

Active learning is closely related to experimental design in statistics [4] for which the Fisher information matrix plays a key role. Current active learning approaches do not directly refer to those concepts, and the Fisher information matrix is rarely used in this context. PTB's working group 8.42 has successfully made use of the Fisher information matrix for detecting adversarial examples and out-of-distribution behavior [5,6].

The goal of the project is to design methods for active learning based on the Fisher information or on uncertainty measures and to provide means for their efficient implementation. Method development will be made in conjunction with medical applications such as image quality assessment for mammography or classification for ECG data.

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References

[1] Mizokami S. *Deep active learning from the perspective of active learning theory*. Deep active learning. Springer, Singapore, 2018. 79-91.
[2] Gal Y, Islam R, Ghahramani Z. *Deep Bayesian Active Learning with Image Data*. ICML 2017: 1183-1192
[3] Wu D, Lin C-T, Huang J. *Active learning for regression using greedy sampling*. Inf. Sci. 474: 90-105 (2019)
[4] Pukelsheim F. *Optimal design of experiments*. Society for Industrial and Applied Mathematics, 2006.
[5] Martin J, Elster C. *Inspecting adversarial examples using the fisher information*. Neurocomputing 382: 80-86 (2020)
[6] Martin J, Elster C. *Detecting unusual input to neural networks*. Applied Intelligence (2020): 1-12.