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Multimodal Signal Processing Using Manifold Learning

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Diskussionsleitung: Prof. W. Kellermann

One of the long-standing challenges in signal processing is the fusion of information acquired by multiple, multimodal sensors. The problem of information fusion has become particularly central in the wake of recent technological advances which have led to extensive collection and storage of multimodal data. Nowadays, many devices and systems, e.g., cell-phones, laptops, and wearable devices incorporate more than one sensor, often of different types. The availability of both distinct and complementary information calls for the development of new theories and methods, leveraging it toward achieving concrete signal processing objectives such as analysis, filtering, and prediction, in a broad range of fields.

In this talk, we consider the case of multiple multimodal sensors measuring the same physical phenomenon, such that the properties of the physical phenomenon are manifested as a hidden common source of variability (which we would like to extract), while each sensor has its own sensor-specific effects. We address this problem using manifold learning, a methodology that lies at the intersection of applied mathematics, machine learning, and data analysis. Specifically, we present a new manifold learning method based on alternating products of diffusion operators and local kernels. We show that the generality of manifold learning makes this method applicable to many real signal processing problems, where different types of devices are used to measure the same activity. In particular, we will present applications to problems in biomedicine, neuroscience, acoustics and audio.