Karlsruher Institut für Technologie

Communications Engineering Lab (CEL)
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Investigation of Semantic Communications in 6G Mobile Communications

Master's Thesis

Project

The upcoming 6G mobile communication standard will offer a multitude of operating modes, realizing connectivity between humans, between machines and enabling a vast amount of applications, ranging from industrial communication to video streaming. The different applications have differing requirements in terms of latency, quality-of-service, robustness and coding/decoding complexity. In this project, your tsask is to investigate so-called semantic communication schemes, i.e., communication schemes that are driven by the content of the message to be transmitted (the message semantics). This entails many a radically new design of the physical layer of the communication system, breaking traditional barriers, e.g., the separation of source and channel coding and non-adaptive digital modulation and radically redesigning next generation communication systems. Using semantic information can also be used to boost the performance of receivers in traditional communication systems, by exploiting the fact that, e.g,. transmission errors cause noticeable glitches in multimedia signals and correcting subsequently for these errors.

Tasks

In this project, your tasks will be to investigate the potential of a redesigned physical layer for semantic communications in the 6G network. We will make use of machine learning methods (in particular deep neural networks) to identify novel transceivers components that use statistical properties of the message content to carry out an adequate encoding and, at the receiver, to enable low-complexity and low-latency message reconstruction. Depending on your own interests, the goals of the thesis can be flexibly adjusted and can either focus on developing and evaluating new methods or on building a demonstrator setup for the distributed low-latency transmission of audio signals (e.g., for distributed music production) with complexity constraints based on an initial setup.

Requirements

- ✓ Basics of digital communications (Communication Engineering I & II / Nachrichtentechnik I & II)
- ✓ Machine Learning and Optimization in Communication Engineering (MLOC)
- ✓ Interest in applying machine learning to communication systems
- ✓ Interest in source coding and decoding techniques
- ✓ Implementing algorithms in Python & PyTorch

Institute

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