IT. Soc. DeepSense 6G Machine Learning Challenge

The DeepSense 6G Machine Learning Challenge is a student competition organized by the Student and Outreach Subcommittee (SOSC) of the IEEE Information Theory Society, in collaboration with the Wireless Intelligence Lab at Arizona State University (ASU). The competition is focused on developing innovative machine learning solutions for various applications using the DeepSense 6G dataset, which comprises coexisting multi-modal sensing and communication data, such as mmWave wireless communication, camera, GPS data, LiDAR, and Radar, collected in realistic wireless environments.

The competition consists of three tasks of increasing difficulty that require participants to use different machine and deep learning modalities and techniques. The scenario considered is as follows: a remote radio head (RRH) is tasked with assisting a base station (BS) in communicating toward a user equipment (UE). The RRH obtains the channel state information (CSI) of the channel between the RRH and UE and wishes to communicate this estimate to the BS through a noiseless but rate-limited channel. The BS reconstructs CSI under a given MSE distortion, while also complementing this estimate through a datastream consisting of radar, lidar, GPS, and image data. This CSI estimate is then used in downstream tasks that are not considered further.

*Task 1: CSI Prediction*

In this task, participants will use regression networks to predict channel quality from radar, lidar, and image data. The goal is to develop a model that accurately predicts the CSI between the RRH and the UE based on the various sensing modalities available at the BS. This task is intended to be a relatively simple warm-up exercise to introduce participants to the DeepSense 6G dataset and the machine-learning techniques they will be using throughout the competition.

*Task 2: Compression with Sensor Fusion at the BS*

In this task, participants will use compression techniques to reduce the amount of data transmitted from the RRH to the BS to communicate the CSI by exploiting the side information available at the BS. Participants will be asked to design a compression and decompression algorithm that exploits the side information at the BS. The compressor should operate at different expected compression rates/MSE error performance.

In particular, the compression and decompression algorithms can rely on a combination of deep architectures with lossless compression algorithms (Huffman, Lempel-Ziv, etc. ) to produce a binary representation of the encoded features which meets the constraint on the expected number of bits to be transmitted over the RRH-BS link.

Additionally, the decoder can rely on the side information available at the receiver as in Task 1: radar, lidar, and image data.

Task 3: Continuous CSI Estimation

In this task, participants are tasked with producing an algorithm that performs efficient CSI estimation over time-correlated measurements. That is, instead of considering a single-shot CSI estimation, the estimation will have to be performed across a set of CSI measurements taken at successive time intervals. Similarly, the BS has radar, lidar, and image data measurements corresponding to the same time instant.

To complete this task, the participants can use techniques such as LSTM, GRU, and attention networks to perform continuous CSI compression.

Overall, the DeepSense 6G Machine Learning Challenge is a student competition that provides an opportunity for undergraduate and graduate students worldwide to apply their machine learning skills to a challenging and relevant real-world scenario. The objective of the competition is to promote the development of innovative machine-learning solutions for various applications using the DeepSense 6G dataset. By participating in the competition, students will gain hands-on experience working with coexisting multi-modal sensing and communication data, and they will be challenged to apply machine learning techniques to real-world scenarios. The competition also aims to foster creativity and innovation among participants, and it provides a platform for students to compete for prizes and recognition.

Next we describe the dataset and detail each task further

Dataset and data loaders

*Task 1: CSI Prediction*

*Task 2: Compression with Sensor Fusion at the BS*

Task 3: Continuous CSI Estimation