"VALERIAN: Invariant Feature Learning for IMU Sensor-based Human Activity Recognition in the Wild" addresses the challenges of training deep neural network models for human activity recognition using inertial measurement unit (IMU) sensors in real-world, naturalistic settings. The paper emphasizes the limitations of existing datasets, which are often collected in controlled environments and lack diversity in terms of subjects and activity types.

In the paper, the authors conduct an empirical analysis of two datasets collected in naturalistic settings to understand the extent and characteristics of label noise. They observe that learning with noisy labels (LNL) methods, including the state-of-the-art DivideMix, fail to achieve good accuracy due to substantial domain gaps among diverse subjects. These gaps make it challenging to distinguish between wrongly labeled data and correct data from different subjects.

Motivated by their findings, the authors propose VALERIAN, an invariant feature learning method for IMU sensor-based HAR. VALERIAN utilizes a multi-task learning approach with separate task-specific layers for each subject. This allows the model to handle noisy labels individually while leveraging shared feature representation across subjects. The method incorporates self-supervised pretraining to learn robust features that are independent of label quality. Early-learning regularization (ELR) is introduced to combat noisy labels by incorporating a loss term reflecting the temporal ensemble of past predictions.

The paper evaluates VALERIAN on four datasets: two controlled datasets and two in-the-wild datasets. The experiments compare VALERIAN against baseline approaches and demonstrate its superior performance. VALERIAN achieves significant label correction, correcting up to 93% of wrongly labeled samples. In domain adaptation, even with 40% label noise in the training data, it achieves approximately 83% test accuracy using only 10 seconds of correctly labeled data per class. Evaluation on a true in-the-wild dataset with noisy labels shows over a 20% improvement in the F1-score compared to baseline methods.

The paper provides implementation details and performance evaluation results for VALERIAN. It also discusses related work in the field of human activity recognition and highlights the unique contributions and differences of VALERIAN compared to existing methods.

If you have any specific questions about the paper or need further clarification on any aspect, feel free to ask.