

Physics-Guided Sim2Real Framework with Edge Deployment Integration

Data Acquisition
(Raw CSI
Streams)

Preprocessing
(Sync, Denoise,
Normalization)

Physics Modeling
(Multipath, Human,
Environment)

Parameterized Synthesis
(Scenario + Channel
Control)

Enhanced Model
(CNN + SE + Temporal
Attention)

Calibrated
Output

Enhanced Model Architecture

Input CSI
[B, 128, 52]

Stem Layer
Conv2d(1→160), BN + SiLU
1,760 params

Block1: DepthwiseSeparable
160→160 + SE(r=12)
31,693 params

Block2: DepthwiseSeparable
160→320 + SE(r=12)
70,266 params

Block3: DepthwiseSeparable
320→320 + SE(r=12)
122,906 params

Temporal Attention
MultiHead(320, heads=4)
411,520 params

Classifier
Linear(320→8)
2,568 params

GPU Speedup: 64.1×
Throughput: 607 sps
Latency: 5.29 ms

Total Parameters: 640,713
Memory: 2.44 MB
Edge Ready: Production