Comprehensive Experimental Evaluation Protocols

SRV protocol

Objective: Validate synthetic
• 540 configurations t
• Noise levels: {0.0, 0.4
• Overlap conditions: {0.0,
• Difficulty: {easy, mediu
• Models: 4 architectures

CDAE Protocol

Objective: Cross-dom
• LOSO: Leave-O
• LORO: Leave-
• 40 configur
• 4 models × 2 pr
• Target: Domain-ag

STEA Protocol

Objective: Label efficiency quantification
• Transfer methods: 4 approaches
• Label ratios: {1%, 5%, 10%, 15%, 20%, 50%, 100%}
• 56 configurations completed
• Target: Minimal real data requirement
• Result: 82.1% F1 @ 20% labels

Protocol Integration and Results

Synthetic Robustness
Synthetic data quality

CDAE Generalization
83.0±0.1% Cross-domain

STEA Efficiency
82.1% @ 20% labels

PSTA: Progre tability

- First systematic Sim2Real study in WiFi CSI HAR
- 83.0±0.1% F1 perfect cross-domain consistency
- 82.1% F1 using only 20% labeled real data
- 80% labeling cost reduction achieved
- Publication-ready trustworthy evaluation

Statistical Validation

- Significance testing: p-values computed
- Confidence intervals: 95% CI reported
- Effect sizes: Cohen's d calculated
- Multiple comparisons: Bonferroni correction
- Cross-validation: 5-fold repeated

Key Performance Summary

Protocol	Key Metric	Achievement
Synthetic	Robustness	540 configs validated
CDAE	Consistency	$\sigma_{CV} < 0.2\%$
STEA	Efficiency	80% cost reduction