Transfer Learning in Wireless Channel Prediction

Jieying Chen, Abdalaziz Sawwan, Shuhui Yang, and Jie Wu
Department of Computer Science, Purdue University Northwest, Hammond, IN
Center for Networked Computing, Temple University, Philadelphia, PA

Introduction

Cellular systems
• Transmit data via radiofrequency (RF) signals
• Provide RF channels for data transmission services
• Four major components
  1. Cellular towers and antennas
  2. Public switched telephone network (PTSN)
  3. Mobile telephone switching office (MTSO)
  4. Mobile subscriber units (MSU)

Channel switching
• Switch RF channels based on
  1. User location
  2. Signal strength
  3. Availability

Transfer learning
• Transfers knowledge from one domain to another
• Subfield of machine learning
• Applications
  1. Computer vision (CV)
  2. Natural language processing (NLP)

Problem Formulation

RF channel switching is
1. Time-consuming
2. Resource-intensive

Transfer learning is
1. Less time-consuming to train models
2. Less data-dependent to train models

Goal: Minimize channel switching

RF channels overlap in 2.4 GHz band
• Combine overlapping channels

Proposed Simulation Techniques

Two cities examined:
• City A (Beijing) and City B (Philadelphia)
• City A —transfer knowledge— City B

Basic model for simulations
• 7-layer DNN for model training
• Latitude + Longitude ~ Channel
• Predict occupied channels of location

Baseline and Upper bound
• Baseline: averaging 100 accuracy of City A —transfer— City B results
• Upper bound: result of training City B model

Varying training data ratio
1. Train certain % of A data
2. Use the same model, train certain % of B data
3. Different combinations of % A and B data

Fine-tune initial learning rates
1. Assign a set of learning rate (LR) for City A
2. For each LR of City A, a set of LR assigns to City B

Evaluation

• As % B increases, accuracy increases.

Conclusion

• Transfer learning is feasible in predicting the used channels in each location
• Propose simulation techniques
• Fine tune DNN model and adjust data ratio to generate test results
• Experiments verify the performance
• Useful when time and data are scarce

The knowledge gained from Beijing (City A) can transfer to Philadelphia (City B).