

Sparsely Connected and Disjointly Trained Deep Neural Networks for Low Resource Behavioral Annotation: Acoustic Classification in Couples' Therapy

Haoqi Li, Brian Baucom, Panayiotis Georgiou
Ming Hsieh Department of Electrical Engineering

Introduction

Motivation:

- Necessity of evaluating human behaviors in psychology
- Build a DNN system that can estimate behaviors

Challenge:

- Data sparsity

Dataset & Feature Processing

Dataset:

- Couple Therapy Corpus
- 134 real distressed couples
- 10-minute dyadic interactions
- 596 sessions (96 hours)

Feature Extraction:

- VAD, speaker diarization
- 6 functionals (mean, max, min...) on Pitch, Intensity, MFCCs, MFBs, Jitter, Shimmer

Methodology

➤ Frame level training:

1) Basic fully connected DNN

- Data sparsity issue → Failure during training

2) Reduced feature dimensionality DNN

- Use a subset of features to train DNN → **More robustly trained DNN**
- Loss of informative features → **Performance degradation**

3) Sparsely-Connected and Disjointly-trained DNN (SD-DNN)

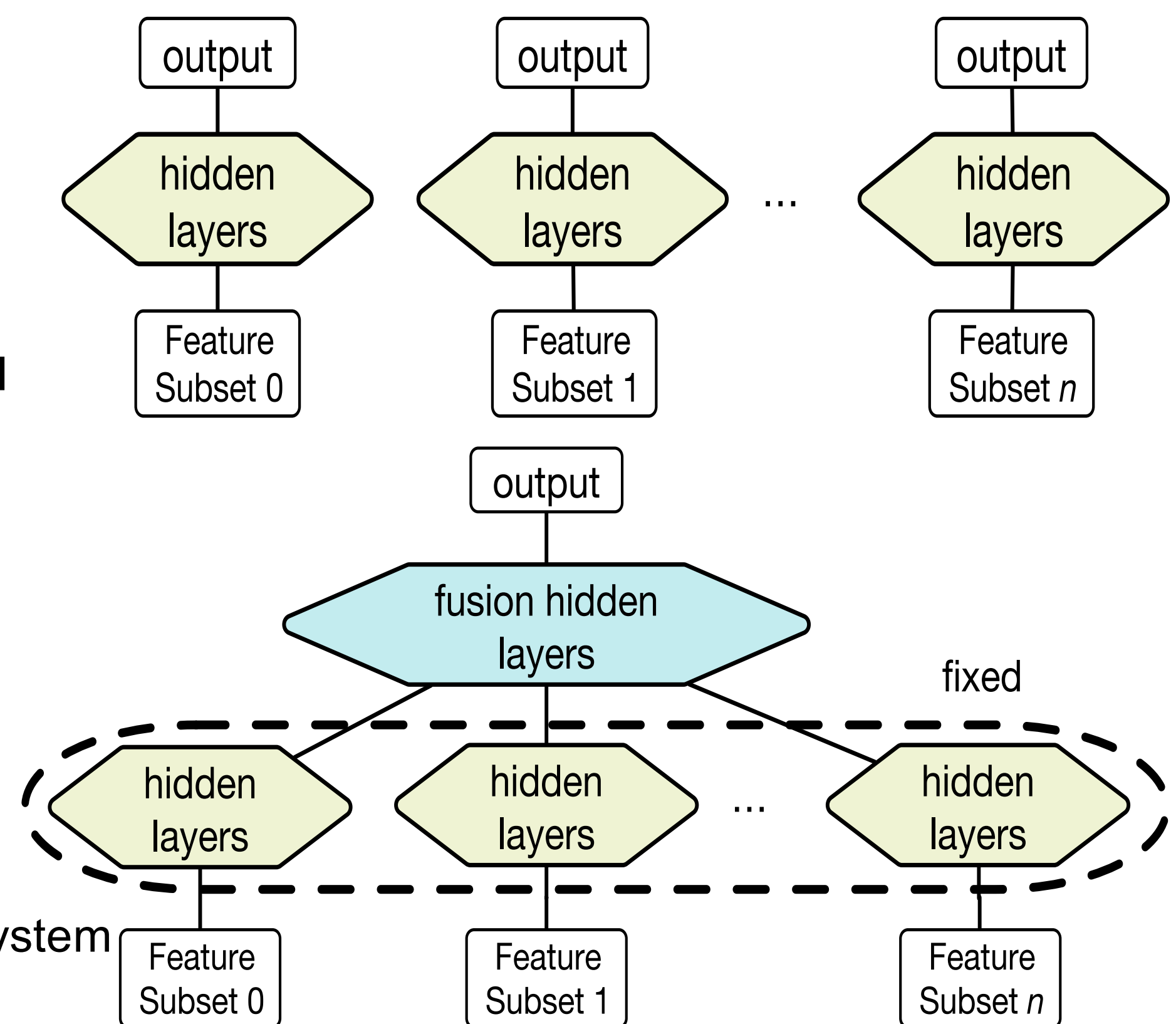
- Train multiple reduced feature dimensionality DNNs
- **Fix** the parameters of individual DNN systems
- Train top hidden layers with new hidden layers as **fusion layers**

4) Joint Optimization of Sparsely-Connected DNN (SJ-DNN)

- Same DNN structure as (3)
- Initialize training from disjoint optimization point and **jointly optimize** system

➤ Session level evaluation:

- Only session-level rating available, employ session level ratings for training and evaluation



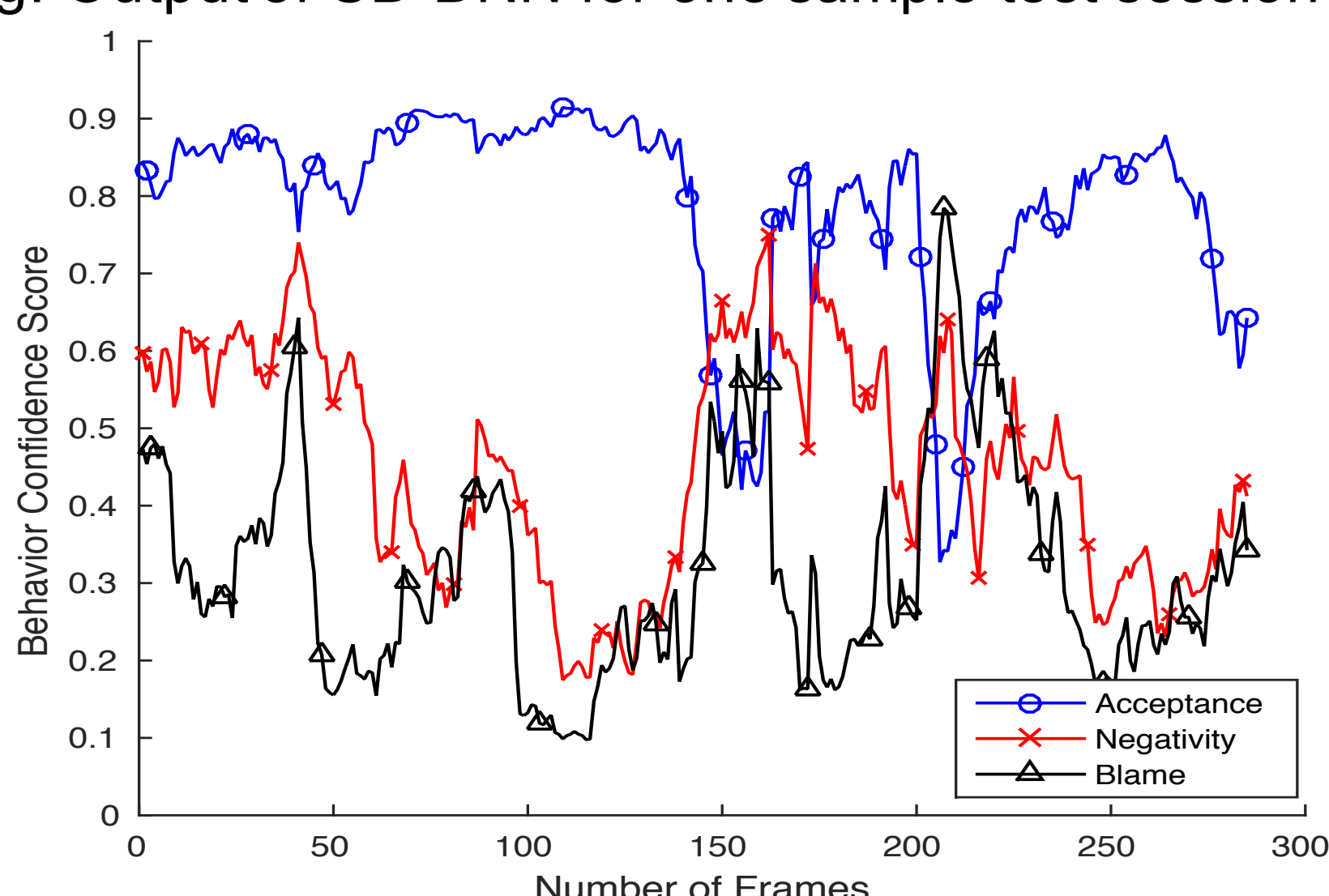
Frame Level Experimental Results

- Classification accuracy (%) for behavior of Acceptance

Knowledge-based feature split

SVM	Pitch	MFCC	Intensity	Intensity	Jitter & Shimmer	Fusion	SD-DNN
68.57	66.07	71.07	66.78	61.43	61.79	72.14	75.36

- Fig: Output of SD-DNN for one sample test session



Session Level Classification Results

Behavior code	SVM	Fully connected DNN	SD-DNN	SJ-DNN
Acceptance	68.57	71.79	75.36	73.57
Negativity	73.21	74.64	77.14	75.36
Blame	73.21	73.93	75.71	74.29

Discussion & Future Work

- Deal with data sparsity in Behavior Signal Processing
- Approach for quantifying behavioral trajectories
- Train complex DNN system despite limited data