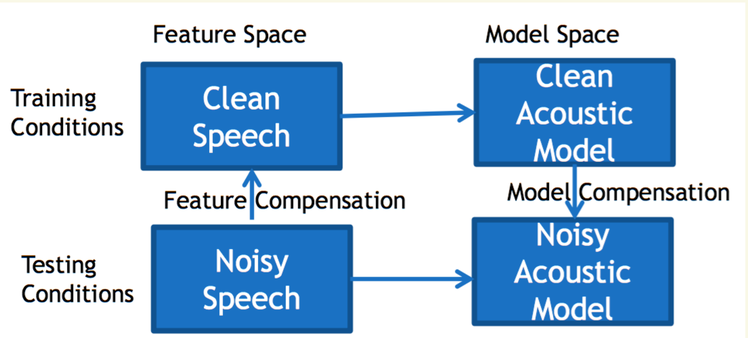
An Investigation of Deep Neural Networks for Noise Robust Speech Recognition

Topic description

- Speech recognition in noisy environment.
- Different noise types: subway, bubble, car, exhibition, restaurant, etc.
- Different SNRs.
- Applications of DNN and effect of dropout.

General solutions overview

- Feature Compensation.
- Model Compensation.



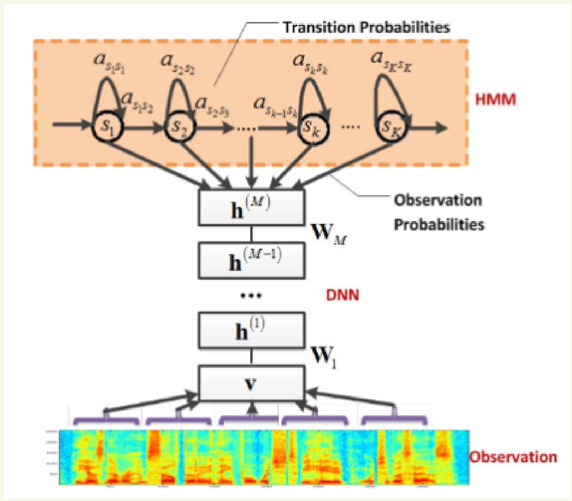
Data

- Tidigit + noise → Aurora 4 (noisy speech).

Set	Clean	Noise types	SNR level
training	✓	subway, bubble, car, exhibition	5, 10,15
test A	⊠	subway, bubble, car, exhibition	-5, 0, 20
test B	✓	restaurant, street, airport	-5 ∼ 20
test C	✓	subway, street	-5 ∼ 20
test D	✓	subway, bubble, car	-5 ∼ 20

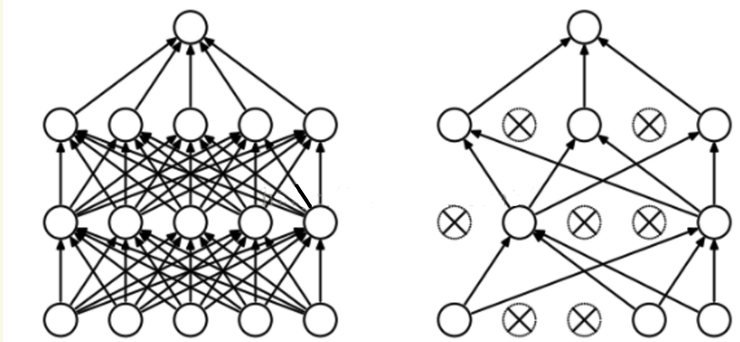
Deep Neural Network acoustic model

- DNN-HMM hybrid with input containing extended context window.



Regularization using dropout

- DNN training with dropout is used to achieve better regularization.
- Avoids overfitting caused by learning the noise.

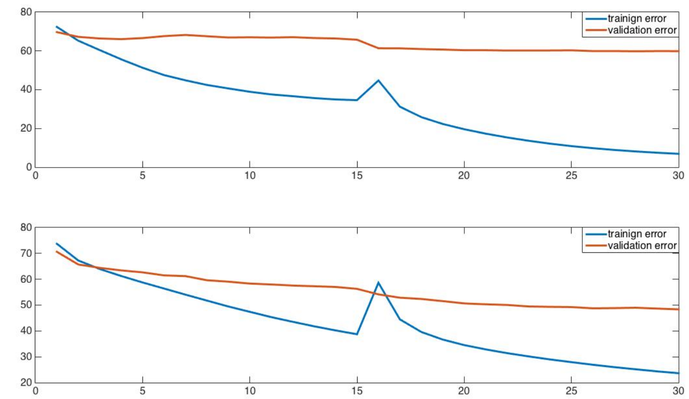


(a) Standard Neural Net (b) After applying dropout.

Experiments

- DNN architecture:
  - 792 input units for FBANK features with first and second order derivatives and 5 frames of context
  - 64 output units for phoneme-states
  - 3 hidden layers with 2048 units each
  - ReLU activation function
- DNN training:
  - 15 epochs with learning rate 0.1
  - 15 epochs of fine tuning with learning rate 0.004
  - SGD with momentum equal 0.9
  - mini-batch size of 512
- Tested variable: 20% of dropout.

Results



Error rate for test sets on frame and phoneme level:

DNN	A	B	C	D	AVG
baseline	63.15	69.39	62.63	62.02	64.30
	54.40	58.92	55.03	54.16	55.63
dropout	50.00	54.03	51.66	52.89	52.15
	42.31	45.93	44.05	45.52	44.45

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