SPHEAR Workshop 2000

# Labeling an Audio–Visual Database and Training an ANN/HMM Audio–Visual Speech Recognition system

SP EAR

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# Overview

- **The Database**
- **The System**
- **Multi–Stage Labeling**
- **Results**
- **Outlook**

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# Database Acquisition

- Transposition of NUMBERS95
  - **Audio–Visual repetition of a subset of NB95 (1700 sentences)**
- Audio and video recordings
  - **Chroma key process to extract lips parameters**

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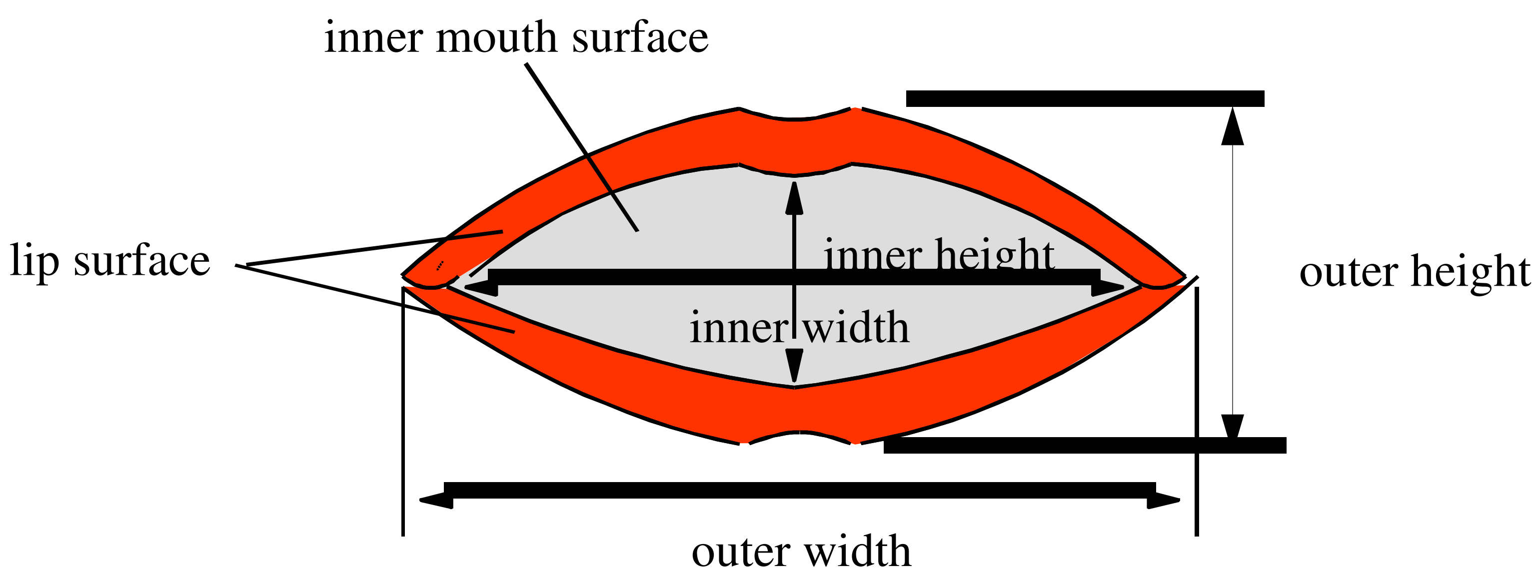
# Lip parameters





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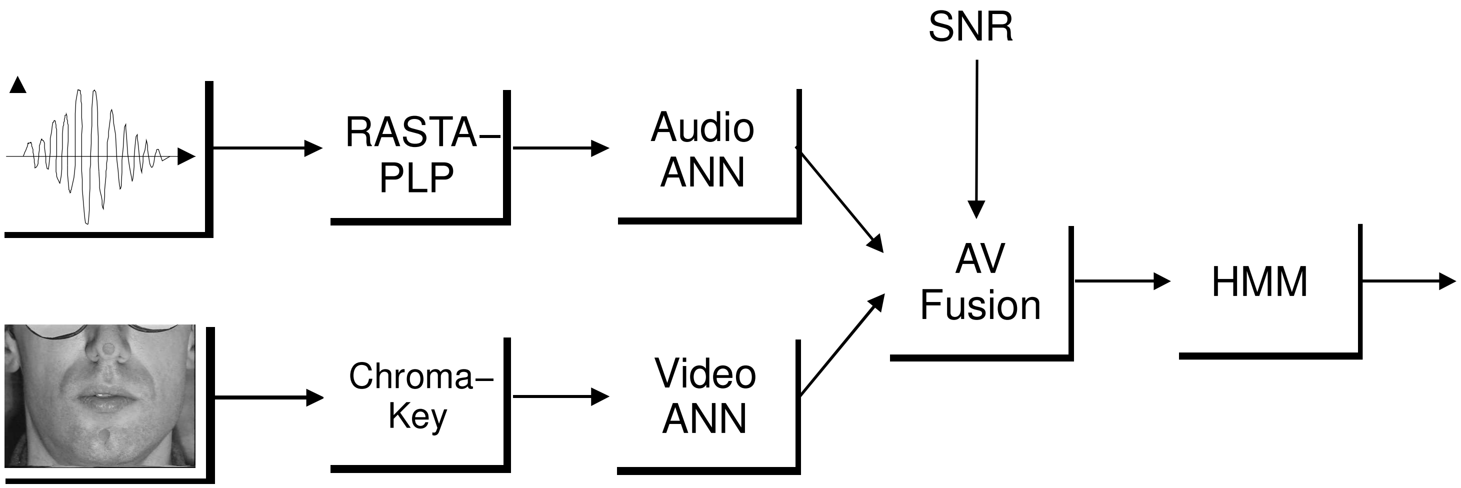
# Recognition System




- Hybrid ANN/HMM audio–visual system (STRUT)
- Separate Identification (SI) structure
- SNR given as contextual information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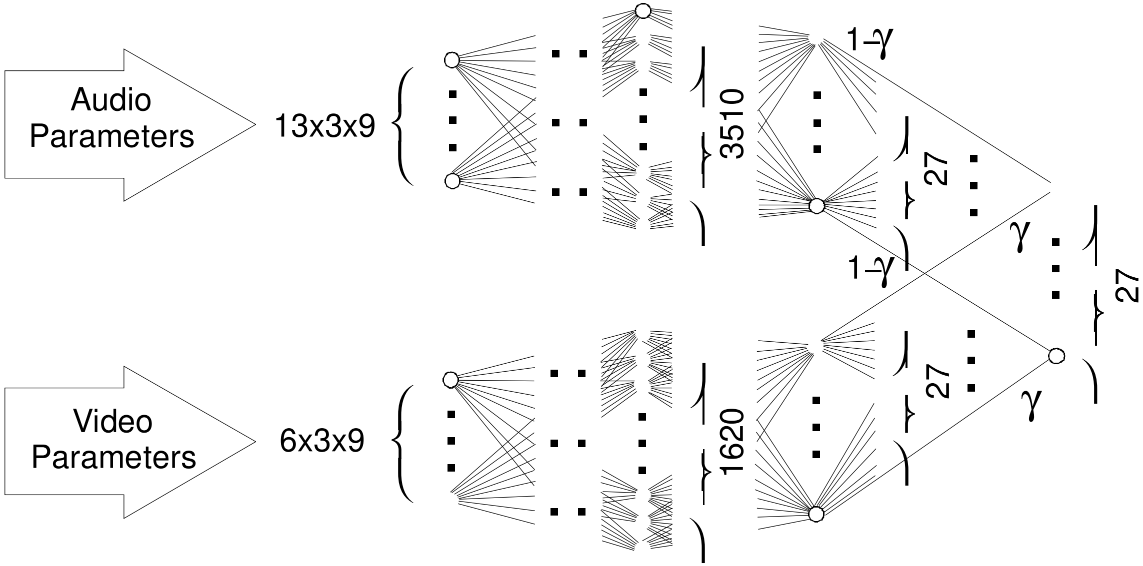
# Recognition System




- Independent weighting of each posterior value for each frame is possible with STRUT

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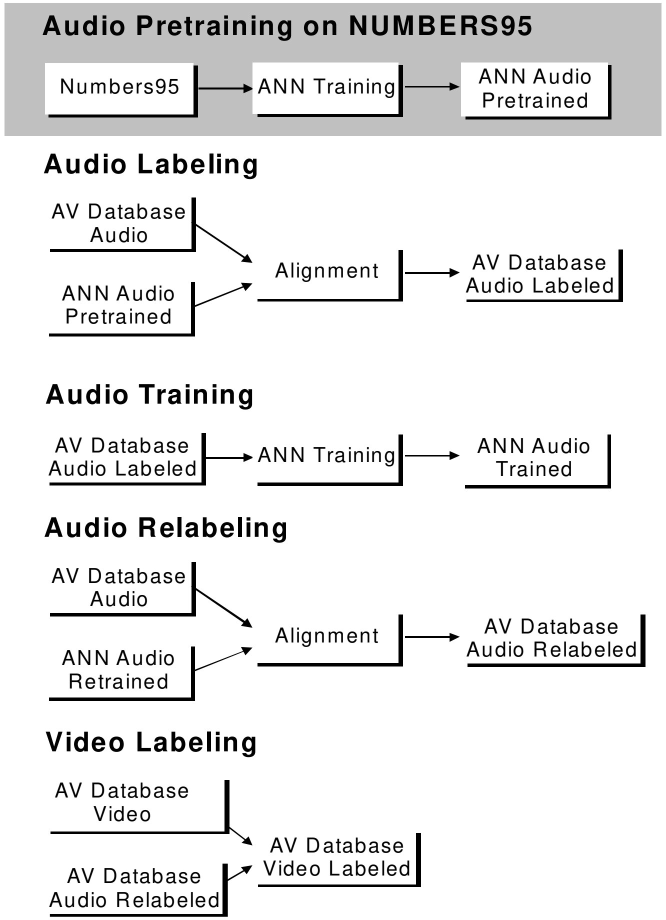
# Recognition System

- Fusion of audio and video via:

$$P(H_i \mid \mathbf{x}_A, \mathbf{x}_V) = P_A^{1-\gamma}(H_i \mid \mathbf{x}_A) P_V^{\gamma}(H_i \mid \mathbf{x}_V)$$

- Phoneme duration modeled via concatenation of states in the HMM
- Dictionary containing 30 words is used
- Grammar free continuous numbers recognition
- No distinction between phonemes and visemes is made

# Multi–Stage Labeling




- **Training on large multi speaker database NUMBERS95**
- **WER on NB95: 11.6%**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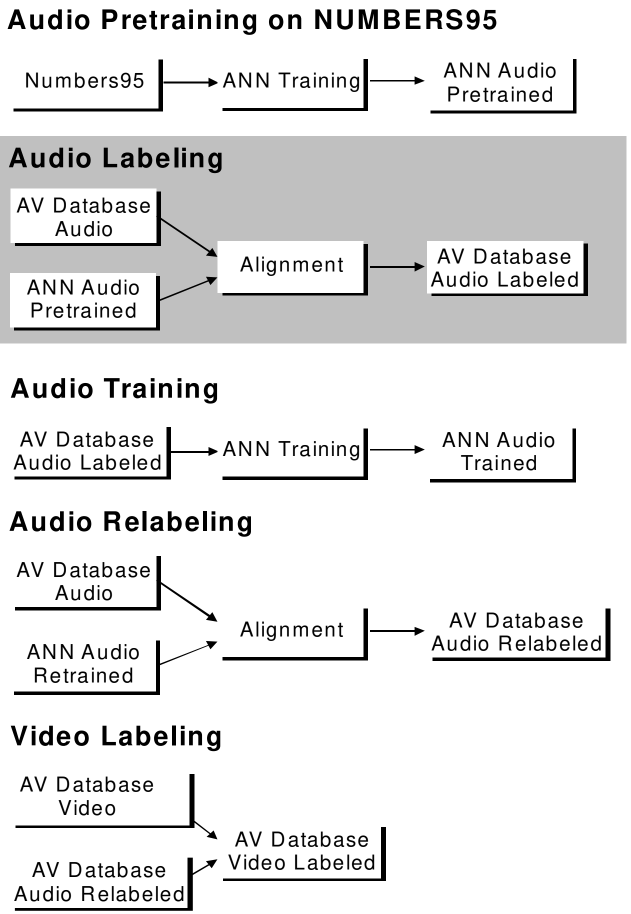
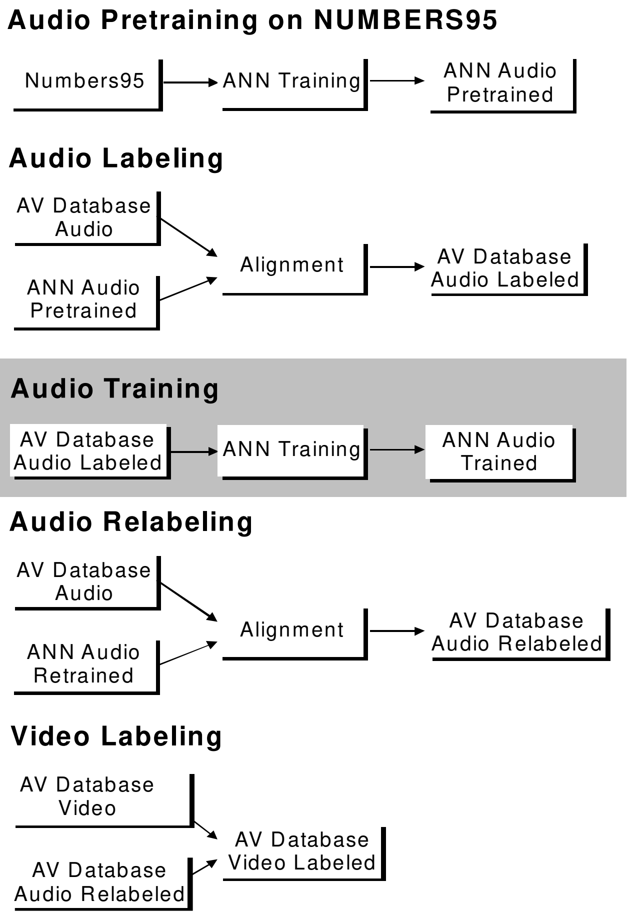
# Multi–Stage Labeling




- **Multi speaker NUMBERS95**
- **WER on NB95: 11.6%**
- **Single speaker Audio–visual NB95**
- **WER on AVNB95: 28.5%**
- **Forced Viterbi alignment**

# Multi–Stage Labeling




- **WER AVNB95 first labeling: 7.1%**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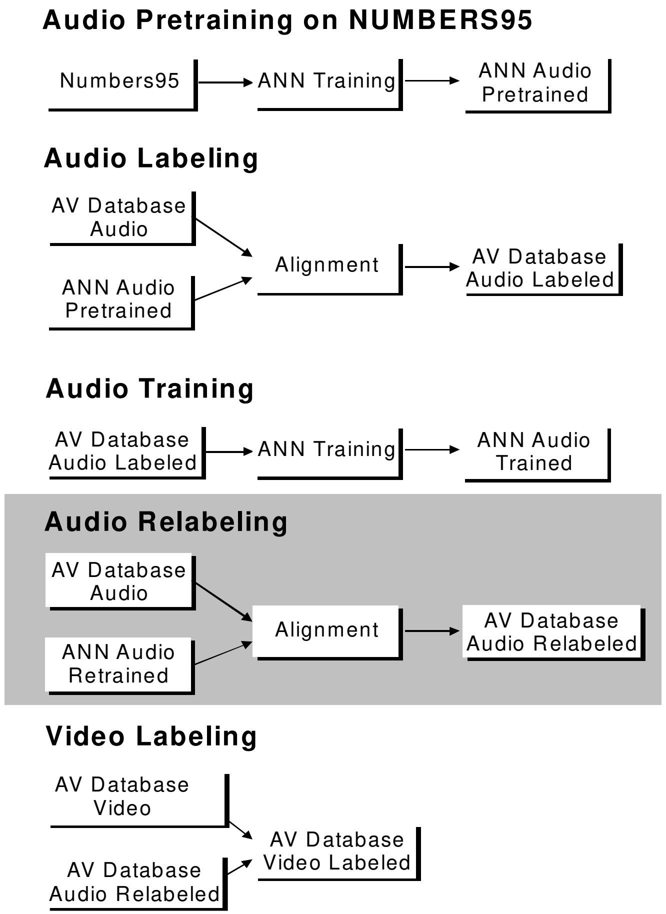
# Multi–Stage Labeling




- **WER AVNB95 first labeling: 7.1%**
- **WER AVNB95 second labeling: 4%**

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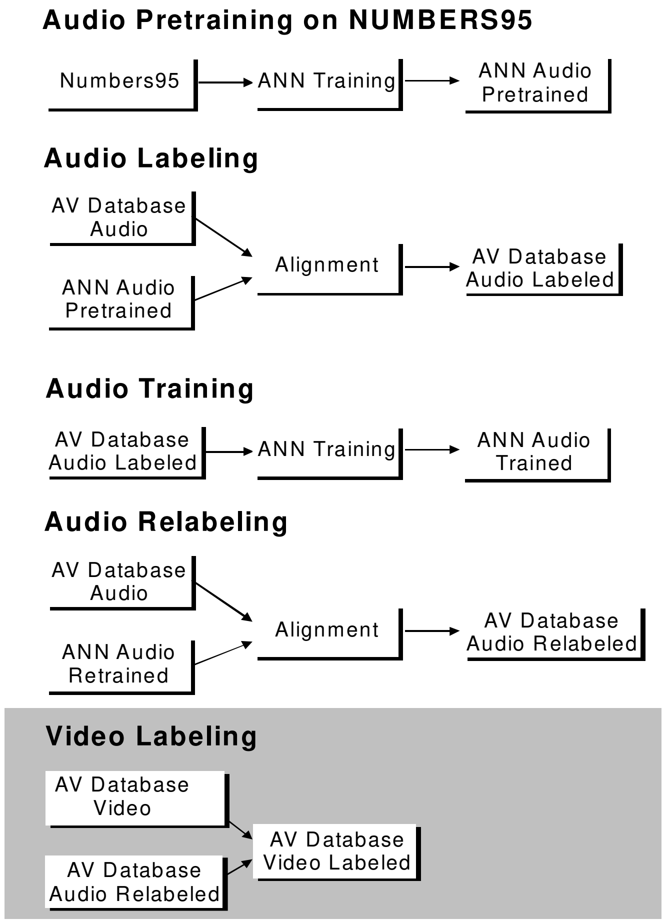
# Multi–Stage Labeling




- **Direct application of the audio labeling to the video path**
- **WER using only video: 35.1%**

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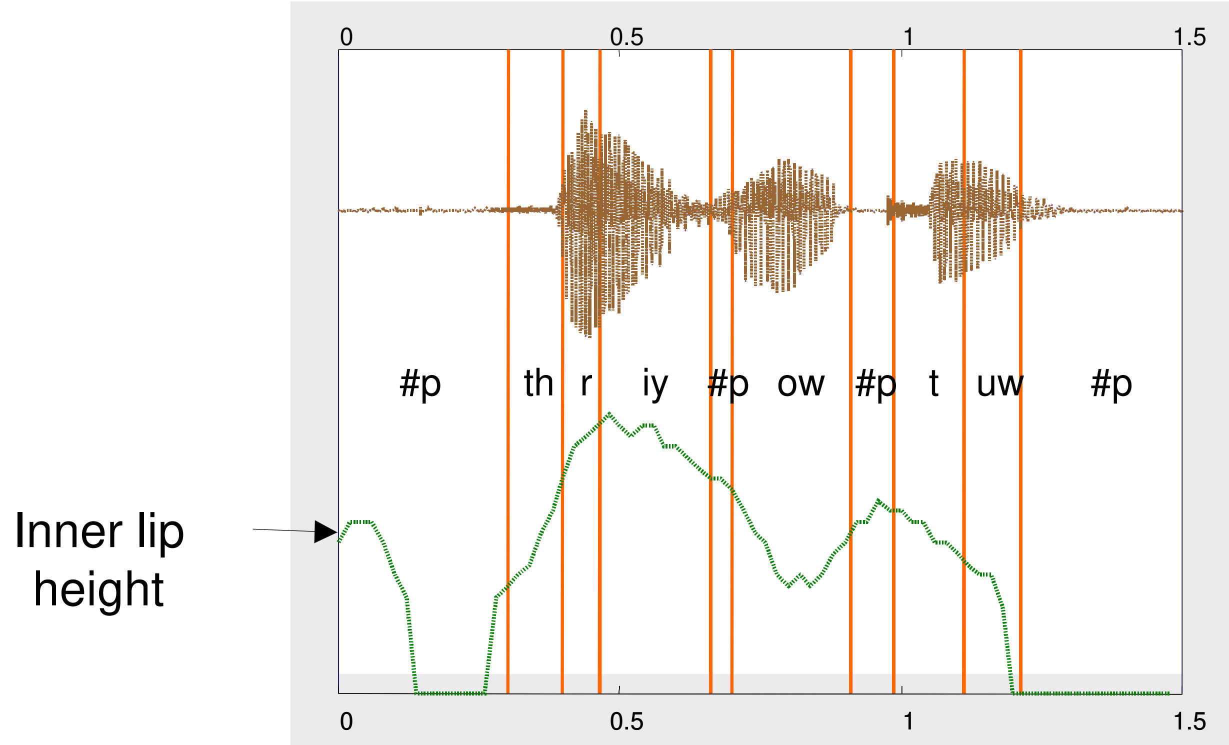
# Result of the labeling




- Result of audio and video labeling for „three oh two“

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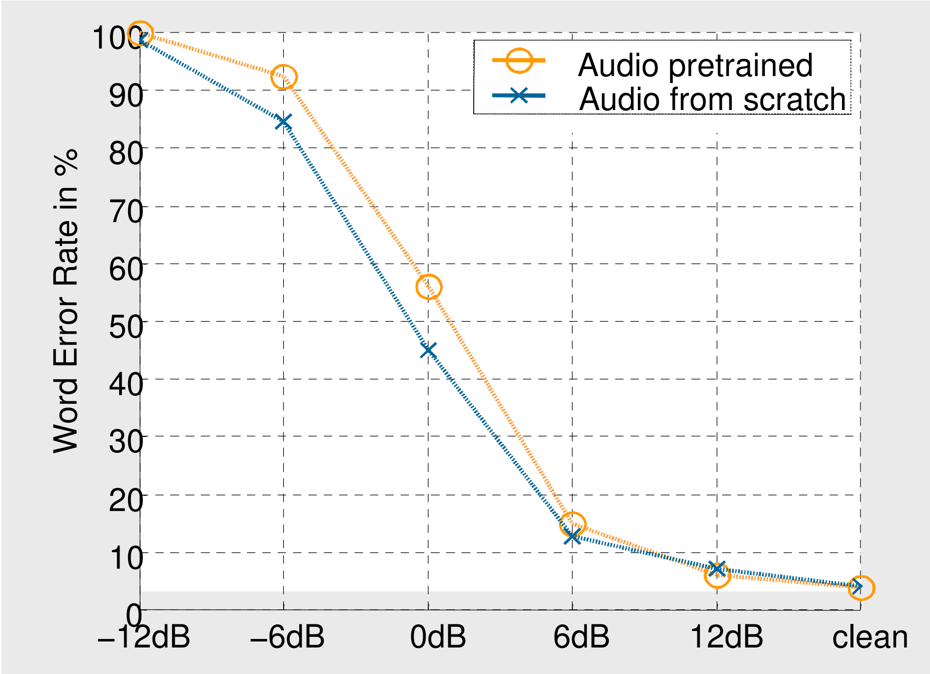
# Effects of Audio Pretraining




- **Comparison between training from scratch on AVNB95 and pretraining on NB95 followed by training continuation on AVNB95**

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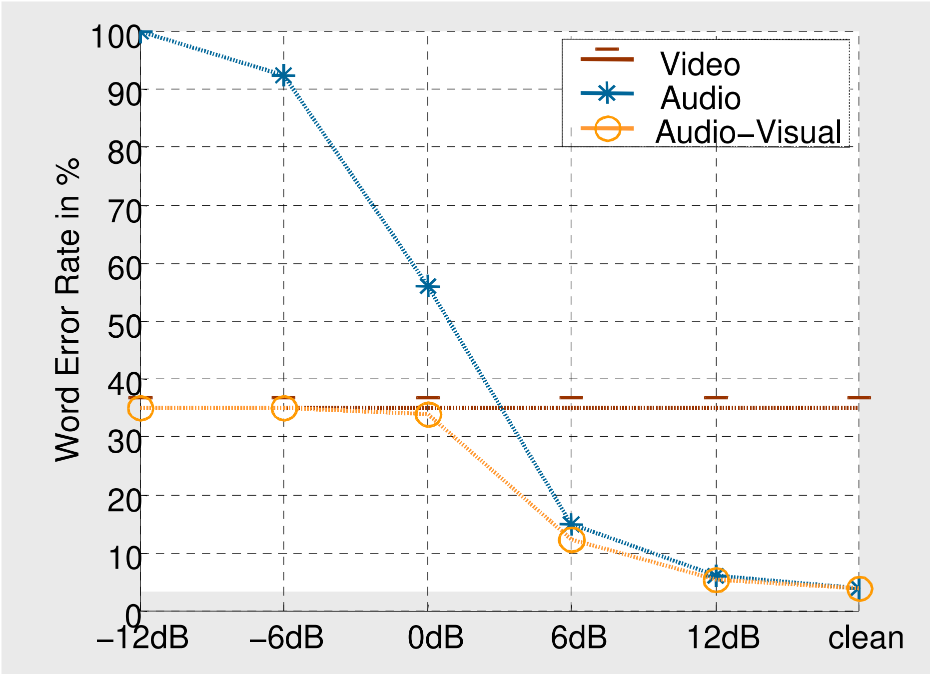
# Audio–Visual Recognition




- **Comparison of audio, video and audio–visual recognition**

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# Conclusion

- Automatic audio–visual labeling process presented
- Pretraining on a large audio database only advantageous for labeling
- Good audio–visual recognition scores with hybrid ANN/HMM system


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# Outlook

- Improvements of the recognition scores via
  - **Grouping of visually identical phonemes to visemes**
  - **Introduction of a more elaborated fusion modality**
- Implementation of a system to determine the weighting of audio and video from the data (e.g. entropy of posteriors) instead of using SNR given as context information

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