

ChIMP: Children Interacting with Machines Project

Undergraduates:

Sonia Khurana, Marni Landes, Talip Ucar

Graduates:

Alison Bryant, Simona Montanari, Serdar Yildirim

Faculty Sponsors:

Shrikanth Narayanan (IMSC)

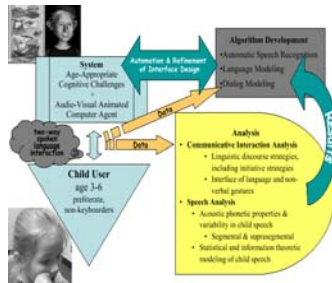
Elaine Andersen (Linguistics & Neuroscience)

Dani Byrd (Linguistics)

Margaret McLaughlin (Annenberg Communication)

Research Goals

- **Long-term:** Examine and model how children interact with machines using natural communication modalities
- Develop new algorithms and interfaces that:
 - Understand child intent
 - Foster a positive and successful child-machine interaction



Functional Block Diagram

Research Approach

- **Specific Goal:** Determine effects of age and signal bandwidth on speech signal features
- Relative information is calculated between cepstral features and the vowel phonetic class for different age groups and signal bandwidths.

$$I(C, Z) = H(C) - H(C|Z) \\ = \sum_c p(c) \int p(z|c) \log \frac{p(z|c)}{p(z)} dz$$

- HMM-based recognizer is implemented using same cepstral features to determine effects of age and signal bandwidth on ASR.

Uniqueness & Related Work

- Information theoretic approach to determine effects of age and bandwidth on cepstral features.
- Part of a larger study that explores linguistic, social and technological issues in the design and implementation of child-machine interactions

RELATED WORK DETAILS: <http://sail.usc.edu/chimp>

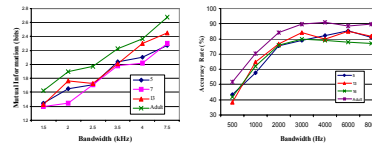
- S. Narayanan and A. Potamianos, "Creating conversational interfaces for children," *IEEE Trans. Speech and Audio Processing*, vol. 10, no. 2, pp. 65-78, 2002.

Role in IMSC

- Development of the natural human – machine communication systems based on spoken interactions.
- Provide an information theoretic model of child speech to explain age-dependent effects in ASR performance due to fundamental limitations in feature extraction.

Accomplishments

- **Results:** Information contained in cepstral features about phonetic classes increases as bandwidth increases
- Cepstral features of adult speech convey more information compared to that of children speech.
- Recognition accuracy increases as bandwidth increases. This is consistent with the (phonetic class dependent) information increase contained in the cepstral features as bandwidth increases.



Papers:

Serdar Yildirim and Shrikanth Narayanan, "An information-theoretic analysis of developmental changes in speech", *Proc. ICASSP* (Hong Kong), April 2003.

Serdar Yildirim, Shrikanth Narayanan, Dani Byrd, and Sonia Khurana, "Acoustic Analysis of Preschool Children's Speech", *ICPhS* (Barcelona, Spain), Accepted to appear, 2003.

5-Year Plan

- Data collection for investigating multimodal interactions in preschool children.
- Gesture Analysis of child-computer interaction.
- Creation of new models and theory of child-machine interactions
- Implementation and demonstration of an educational prototype.

