Robust Speech Recognition
Program Summary
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The Lincoln Laboratory Program in Robust Speech Recognition Technology was initiated in FY85 with the major goal of developing techniques for high-performance speech recognition under the stress and noise conditions typical of the fighter cockpit. After achieving significant advances in robust isolated-word recognition (IWR) during FY85 and FY86, the program evolved in FY87 to the development of robust continuous speech recognition (CSR) techniques for the stressful, limited-task-domain environment typical of the Pilot's Associate. In FY88, the Lincoln CSR work was extended successfully to the large-vocabulary task typical of the Battle Management environment. A major goal of the current program, starting in FY89, is to extend and apply these robust CSR techniques to talker-independent, noisy and distorted speech conditions.

The work in recognition in stress and noise produced a robust Hidden Markov Model (HMM) IWR system with 99% speaker-dependent (SD) accuracy for several difficult stress/noise databases, and very high performance for normal speech. Robustness techniques which were developed included multi-style training, robust estimation of parameter variances, use of time-differential speech parameters, and discriminant analysis.

More recently, the robust HMM system has been extended to large-vocabulary CSR for both speaker-dependent (SD) and speaker-independent (SI) tasks. Performance on the DARPA Resource Management task (991-word vocabulary, perplexity-60) is 96.5% word accuracy (SD) and 87.5% word accuracy (SI). The robust HMM CSR has also been integrated in real-time with a simulated flight task, judged to be very realistic by a number of military pilots. Phrase recognition accuracy on the limited-vocabulary flight task is better than 99.5%.

Goals for the current program include: (1) development of robust techniques for talker-independent recognition of noisy and distorted continuous speech; (2) research into the application of speaker recognition strategies to improve speech recognition performance; and (3) continued development and evaluation of CSR techniques on the DARPA Resource Management continuous-speech database.

References

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[2] Lincoln Laboratory papers in Proc. DARPA 1987 Speech Recognition Workshop, pp. 82-104.

[3] D.B. Paul and E.A. Martin, "Speaker Stress-Resistant Continuous Speech Recognition," ICASSP'88.

[4] D.B. Paul, "The Lincoln Robust Continuous Speech Recognizer," ICASSP'89.