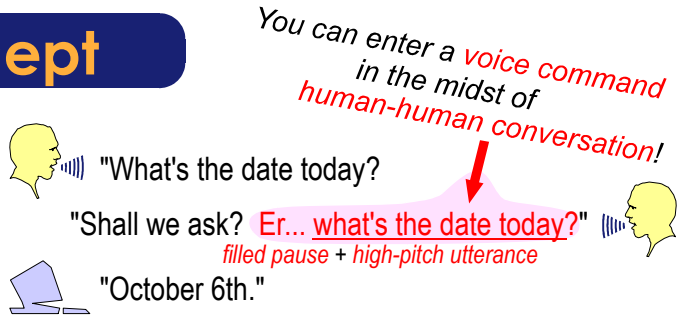
Speech Spotter

On-demand Speech Recognition in Human-Human Conversation on the Telephone or in Face-to-Face Situations

Concept

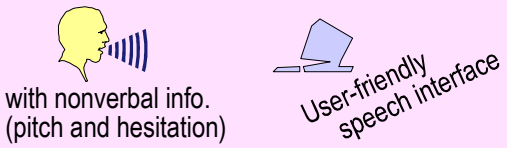


New Direction of Speech Interface

❑ Exploit nonverbal speech information

- Current speech-input interfaces have not fully exploited the potential of speech
- Most speech recognizers utilize only verbal (phoneme) information

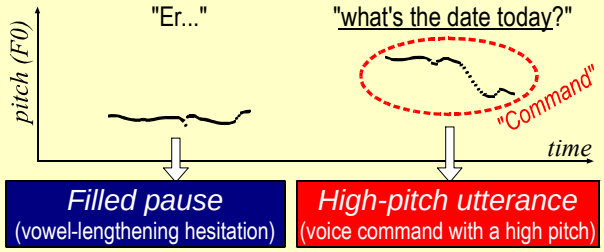
➡ Make use of nonverbal speech information intentionally controlled by a user



Speech Spotter

❑ What is speech spotter?

- Enable a user to enter voice commands into a speech recognizer in the midst of natural human-human conversation
- The system monitors human conversation and accepts only a *speech-spotter utterance* that does not appear in natural conversation
- Use two kinds of nonverbal speech information



This is intentionally unnatural!

- Benefits
  1. Can immediately use a speech recognizer whenever needed
  2. Can use even in telephone conversation
     Hands-free interface with only microphone
     User is free regarding body movement
  3. Can feel free to use any words in conversation
     Not have to carefully avoid saying anything that the system will accept

Previous Interfaces

❑ Difficult to use speech recognition in human-human conversation

- Cannot judge whether a user is talking to another person or the system
- Previous word-spotting approaches
  Voice command is preceded by a keyword
  "Computer", "Casper", "Maxwell", etc.
  User was forced to avoid use of the keyword
- Use other input devices (button or camera)
  The usual behavior of a user is restricted
  Cannot be used in telephone conversation

➡ No practical means using only microphone input

Application Systems

❑ On-demand information system for assisting human-human conversation

- Obtain information while talking to another person
  System provide info. only when asked for it
  - Weather information *(obtained from WWW)*
    Local weather forecast for today, tomorrow, etc.
  - Date and time information *(obtained from NTP)*
    Today's date and time
  - News information *(obtained from WWW)*
    Latest news headlines regarding world affairs, business, sports, and entertainment

❑ Music-playback system for enriching telephone conversation

- Listen to background music while talking to another person on the telephone
  - Saying the song title *(on SQL database server)*
    Play back the appropriate song (title on the screen)
  - Saying the artist's name
    Show a numbered list of song titles for that artist
    Play back the song selected by its title or number

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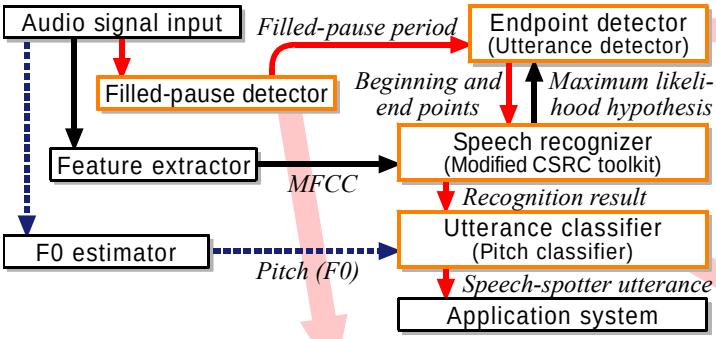
Implementation

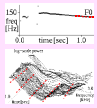


Endpoint Detector

- Detect the beginning of an utterance
  - Determine as being 130 ms before the FP end
- Detect the end of an utterance
  - Determine by checking the ML hypothesis
    - Stop when there is no possibility of other words
    - Stop when the hypothesis reaches the silence pause

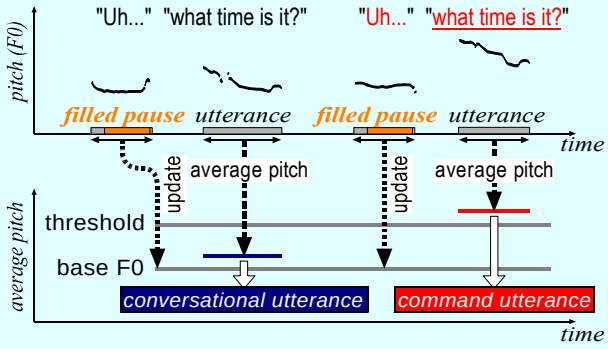
Filled-Pause Detector

- Detect both ends of each filled pause
  - Real-time filled-pause (FP) detection method [Goto *et al.* 1999]
    - Independent of vocabulary and language
    - Detect a lengthened vowel in any word
  - Detect two acoustical features of FP
    - Small pitch transition
    - Small spectral envelope deformation



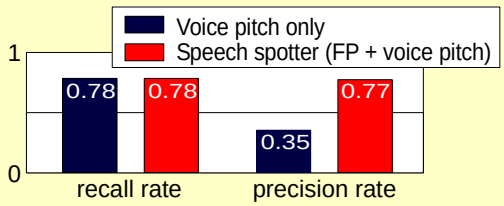
Utterance Classifier

- Distinguish between normal and high-pitch utterances
  - Difficult to judge whether the pitch is raised
    - Pitch range differs among individuals
  - *Base fundamental frequency (base F0)*
    - Unique pitch reference for each speaker
    - Estimate by averaging the voice pitch during a filled pause (FP) *(e.g., "uh...")*
  - Use pitch value relative to the *base F0*
- Thresholding method



Experimental Results

- Evaluation of detection performance
  - Compare the speech-spotter function with a method w/o using the preceding FP
  - Tested on 40-minute corpus consisting of normal and speech-spotter utterances
    - Uttered by 12 Japanese subjects
    - 218 speech-spotter utterances



⇨ *Use of preceding FP is important*

- Usability of two application systems
  - Easy to use, can be used without any training
  - Convenient, suitable for use in conversation
  - Appreciate novelty and usefulness
    First system that people can use to obtain speech-based information assistance in telephone conversation

Summary

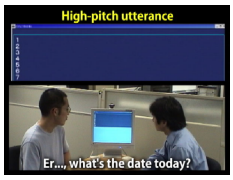
- Propose a new speech interface function "Speech Spotter"
  - Unnaturalness of nonverbal speech info. can be used as a practical interface function
  - User can intentionally control whether each utterance is accepted (processed) by the speech recognizer
  - General idea can be used in other applications

Video Clips

Video clips of our speech-interface projects:
http://staff.aist.go.jp/m.goto/SpeechCompletion/
http://staff.aist.go.jp/m.goto/ICSLP2004/

On-demand information system for assisting human-human conversation

A: Hey, I've suddenly forgotten... What is the date today?
B: Yes, what is today's date? Well, shall we ask the On-Demand Conversation Assistance System? Er..., what's the date today?
** The system displays the current date and time: ``August 22, 2003, Friday, 23:51:10 JST''*
A: Uh, it's already the 22nd!
B: Oh really? Well, that means our excursion is tomorrow. I hope it doesn't rain.
A: Shall we ask about the weather too? Er..., what's tomorrow's weather?
** The system checks tomorrow's weather report and displays the result: ``Clear''*
B: Uh, no rain. Great!
A: That's good!



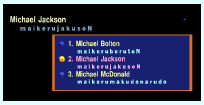
Music-playback system for enriching telephone conversation

B calls A on the telephone.
A: Yes...
B: Hello?
A: Uh..., what's up?
B: Thanks for all your help last time.
A: No problem. How have you been since?
B: Whew! I've been super busy writing that paper... I'm beat.
(Several minutes later)
A: Uh..., that reminds me, the song called ``Fly Away'' that we heard at that place, wasn't that good?
B: Oh, what song was that?
A: Shall we try listening to it?
B: What? We can hear it now?
A: Sure. This is a phone with a music-playback system. We can listen to that song like this... Er..., ``Fly Away''!
** The system plays the song of that name on both of their handsets.*
B: Wow, amazing! You can listen to a song by just saying its name! Um..., this is a good song.
A: That's right!
(The conversation continues about various songs.)

Future Directions

❑ Interfaces using intentional nonverbal info.

1. "Speech Completion" [HCI Intl. 2001] [ICSLP 2002]
2. "Speech Shift" [Eurospeech 2003]
3. "Speech Starter" [Eurospeech 2003]
4. "Speech Spotter" [ICSLP 2004]
5. "Speech ???"



Further developing this concept...

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