Natural Speech Technology

Edinburgh – Cambridge – Sheffield

# Browsing Oral History

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# Oral History

- Captures the personal and historical experiences of individuals
- Many collections:
  - English Heritage
  - Heritage Lottery (funded 2000)
  - British Library
- Memories, reminiscences
- Long Interviews
- No central database..
- Utility limited by retrieval problems.. *The Deep Dark Secret of oral history …that nobody spends much time listening to or watching recorded and collected interview documents'* (Frisch (2008)

# Oral History Collections

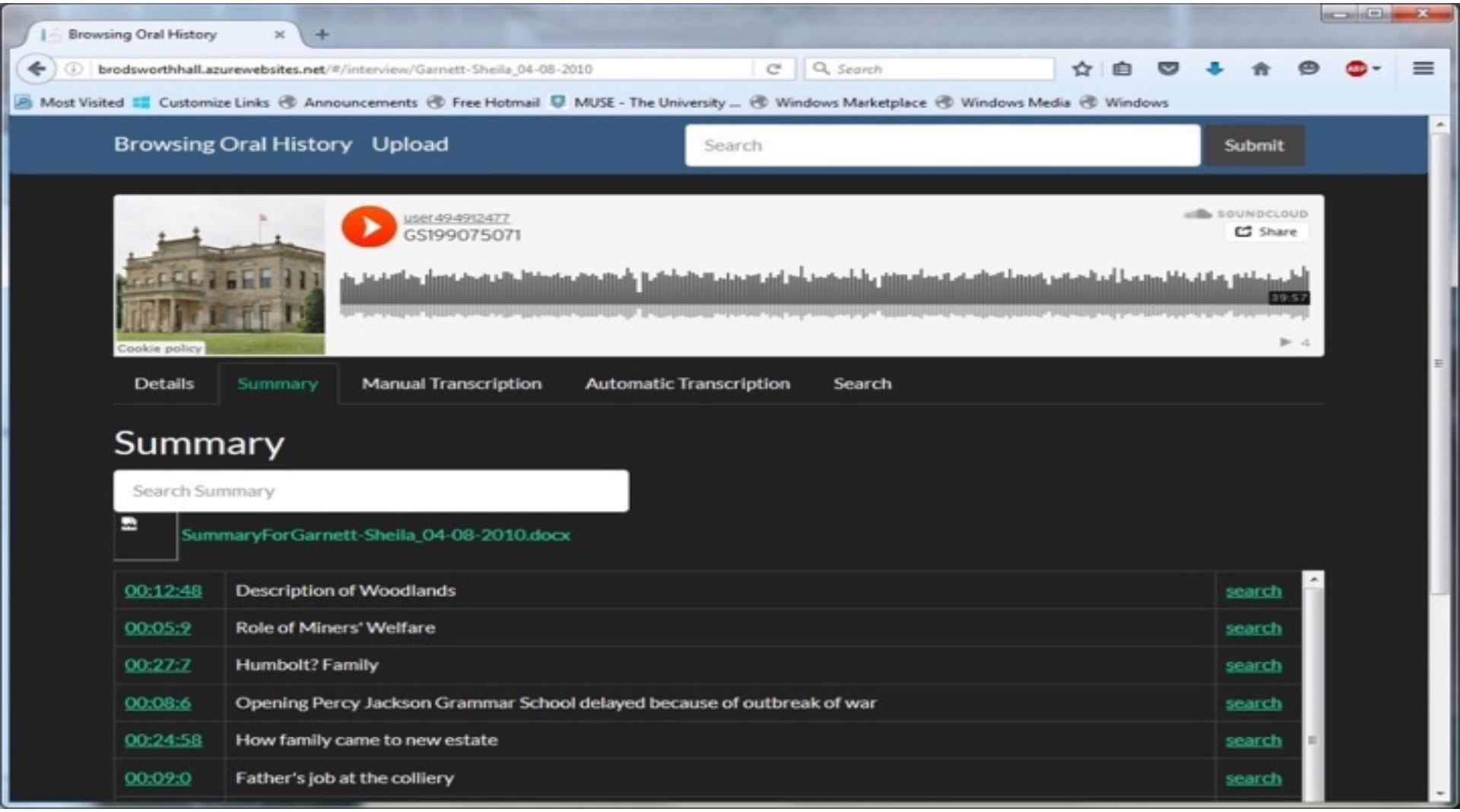
- Topic-focussed (but topic may be very wide)
- Data back to the 1990s (at least)
- Variable recording quality
- Metadata
  - Typically summary of an interview
  - Occasionally  a transcription
- OOV problems .. Use the summary


Oral History recordings .. WWII experiences

- around 25 interviewees
- ~50 hours

# Using Speech Technology to Browse Oral History

- ASR Transcription as a browsing tool
- Link Audio, summary and ASR
- Browsing Tool for Duty Calls ('System1')
  - Transcribed with a Sheffield MGB system
  - Speech activity detection based on DNNs
  - 4 independent speaker adapted systems (2 DNN-HMM and 2 DNN-GMM-HMM) trained on 700 hours of BBC broadcasts
  - Lexicon of 50,000 words
  - 4-gram language model and RNN rescoring, trained on 700 million words
- Demo on http://brodsworthhall.azurewebsites.net
- 3 interviews .. with permission

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# Recognisers for Duty Calls

System 1

- Sheffield MGB system
- Speech activity detection based on DNNs
- 4 independent speaker adapted systems (2 DNN-HMM and 2 DNN-GMM-HMM) trained on 700 hours of BBC broadcasts
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System 2

- SI Hybrid system,
- sequence trained 700hrs trained on MGB data.
- LM data from MGB systems (includes subtitle data).
- IBM KWS

# Duty Calls: Trial Corpus

Ground Truth: 8 interviews manually transcribed

| | Sheila Coates | Jean Covell | Joyce Durdy | Ernest Egginton | David Gilling | Sheila Miles | Jean Paton | Madge Rouse | Total |
|---|---|---|---|---|---|---|---|---|---|
| Duration | 33'39” | 1h13' | 16'29” | 47'54” | 1h43' | 12'47” | 39'42” | 21'38” | 5h49' |
| Segments | 666 | 1,965 | 259 | 1,151 | 2,203 | 335 | 949 | 392 | 7,919 |
| Words | 4,605 | 12,399 | 1,992 | 6,647 | 18,608 | 2,041 | 5,843 | 2,563 | 54,698 |

# Duty Calls: using the Summaries

7 interviews contain a summary

| | Sheila Coates | Jean Covell | Joyce Durdy | Ernest Egginton | David Gilling | Sheila Miles | Jean Paton | Madge Rouse | Total |
|---|---|---|---|---|---|---|---|---|---|
| Words | 544 | 0 | 663 | 1,600 | 891 | 505 | 370 | 853 | 5,426 |

A set of relevant named entities (e.g. “Hooton Pagnell”) were manually identified from the summaries, and matched to spoken occurrences in the audio

| | Sheila Coates | Jean Covell | Joyce Durdy | Ernest Egginton | David Gilling | Sheila Miles | Jean Paton | Madge Rouse | Total |
|---|---|---|---|---|---|---|---|---|---|
| Entities | 41 | 0 | 23 | 23 | 74 | 5 | 29 | 45 | 240 |

Many of the named entities are not in the vocabulary (~40-50%)

When they are, they are underrepresented in the LM training data (either n-gram or RNN)

# Duty Calls: finding named entities

Evaluation of WER and Recall of named entities using two different systems

WER over 30%, recall 35%-40% with a high precision (100%-94%)

| System 1 | Sheila Coates | Jean Covell | Joyce Durdy | Ernest Egginton | David Gilling | Sheila Miles | Jean Paton | Madge Rouse | Total |
|---|---|---|---|---|---|---|---|---|---|
| WER | 31.2% | 34.0% | 19.0% | 43.9% | 35.2% | 46.2% | 27.5% | 33.6% | 34.4% |
| Recall | 24.4% | N/A | 73.9% | 26.1% | 36.5% | 20.0% | 51.7% | 20.0% | 35.4% |
| System 2 | Sheila Coates | Jean Covell | Joyce Durdy | Ernest Egginton | David Gilling | Sheila Miles | Jean Paton | Madge Rouse | Total |
| WER | 37.9% | 35.8% | 24.0% | 45.6% | 33.9% | 51.1% | 33.0% | 40.4% | 36.3% |
| Recall | 24.4% | N/A | 73.9% | 39.1% | 50.0% | 0.0% | 55.2% | 20.0% | 40.8% |

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# Duty Calls: adapting the Language Model from the Summary

Lexicon and language model adaptation using the interview summary:

- A new lexicon is created for each summary adding words from the summary
- A new 4-gram is trained interpolating the baseline LM with the summary n-gram
- RNN is fine tuned using the summary

Small WER improvement, but recall increased to >60%

| System 1 | Sheila Coates | Jean Covell | Joyce Durdy | Ernest Egginton | David Gilling | Sheila Miles | Jean Paton | Madge Rouse | Total |
|---|---|---|---|---|---|---|---|---|---|
| WER | 31.6% | N/A | 17.3% | 42.3% | 35.1% | 42.2% | 28.6% | 31.4% | 34.1% |
| Recall | 48.8% | N/A | 87.0% | 52.2% | 68.9% | 40.0% | 69.0% | 62.2% | 63.8% |

Precision 92%

# LM Adaptation Across Summaries

Lexicon and language model adaptation using a pool of all summaries:

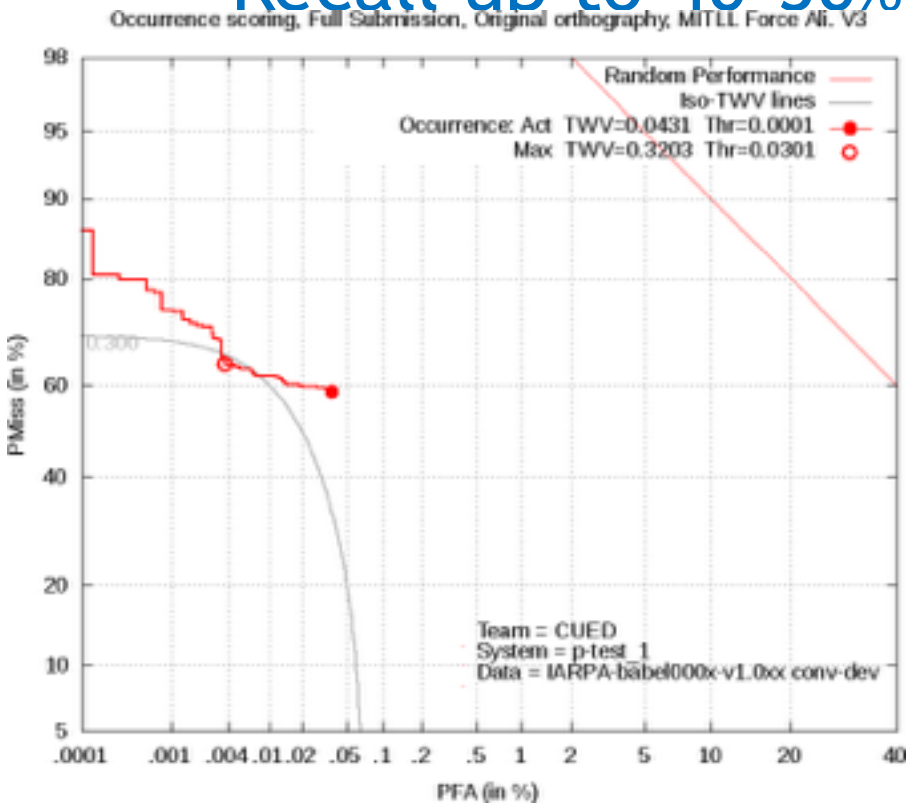
| System 1 | Sheila Coates | Jean Covell | Joyce Durdy | Ernest Egginton | David Gilling | Sheila Miles | Jean Paton | Madge Rouse | Total |
|---|---|---|---|---|---|---|---|---|---|
| WER | 30.7% | 34.8% | 16.2% | 42.7% | 34.3% | 42.4% | 27.7% | 27.7% | 33.6% |
| Recall | 51.2% | N/A | 91.3% | 39.1% | 68.9% | 20.0% | 58.6% | 82.2% | 65.4% |

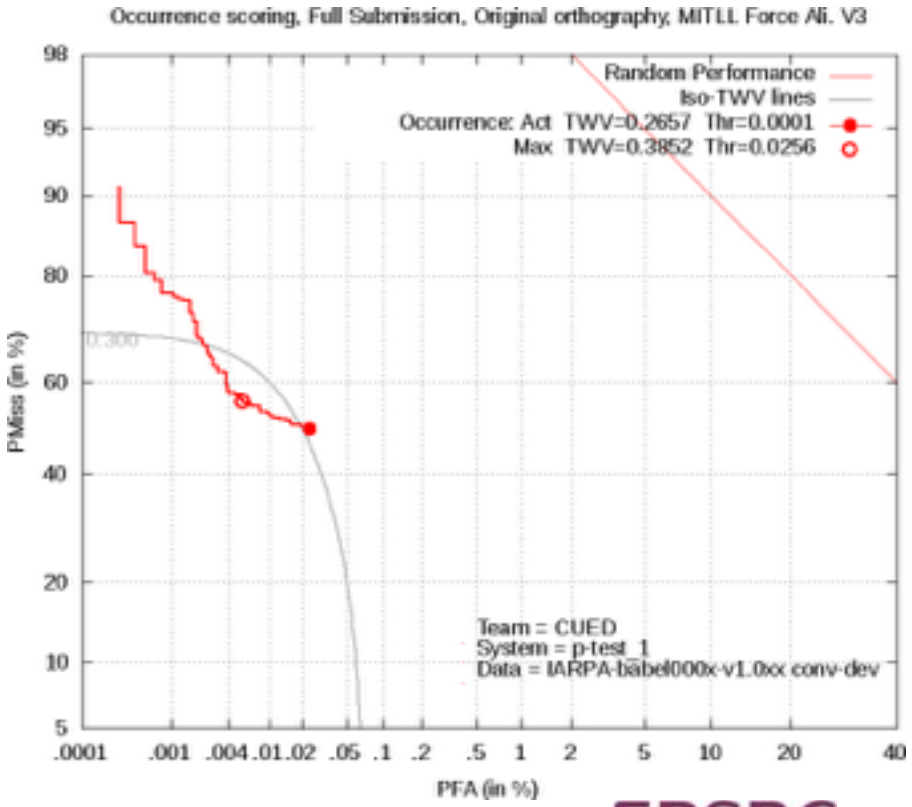
Precision 92%

# Duty Calls: Keyword Spotting from Lattices

A different operating point can be chosen from the DET curves (keyword spotting based on lattices)

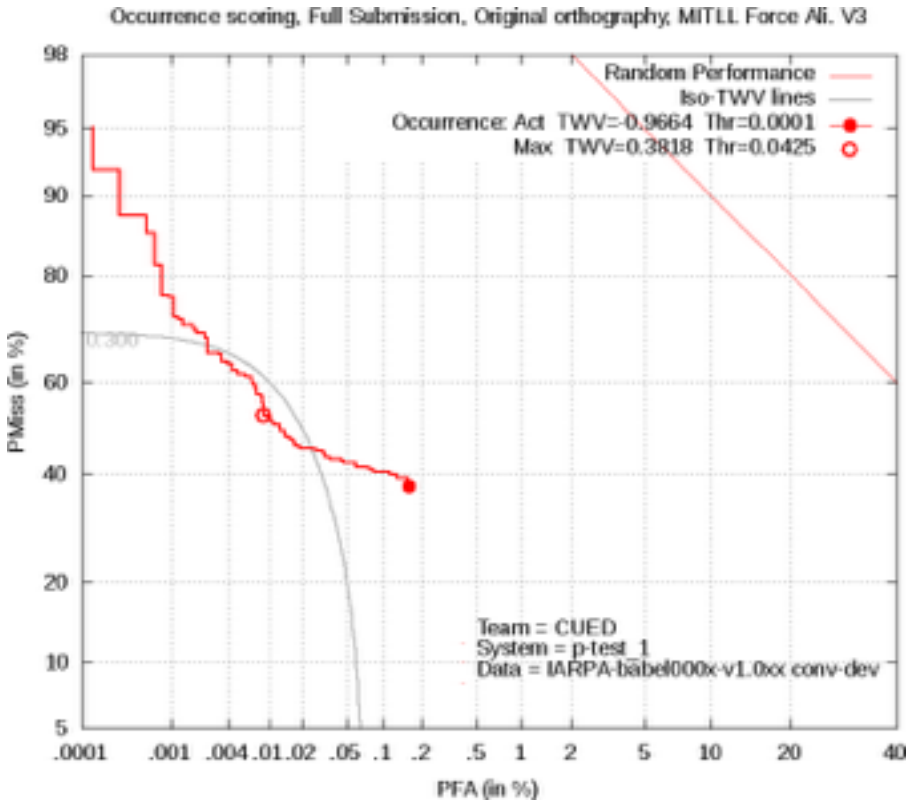
- Recall up to 40-50%

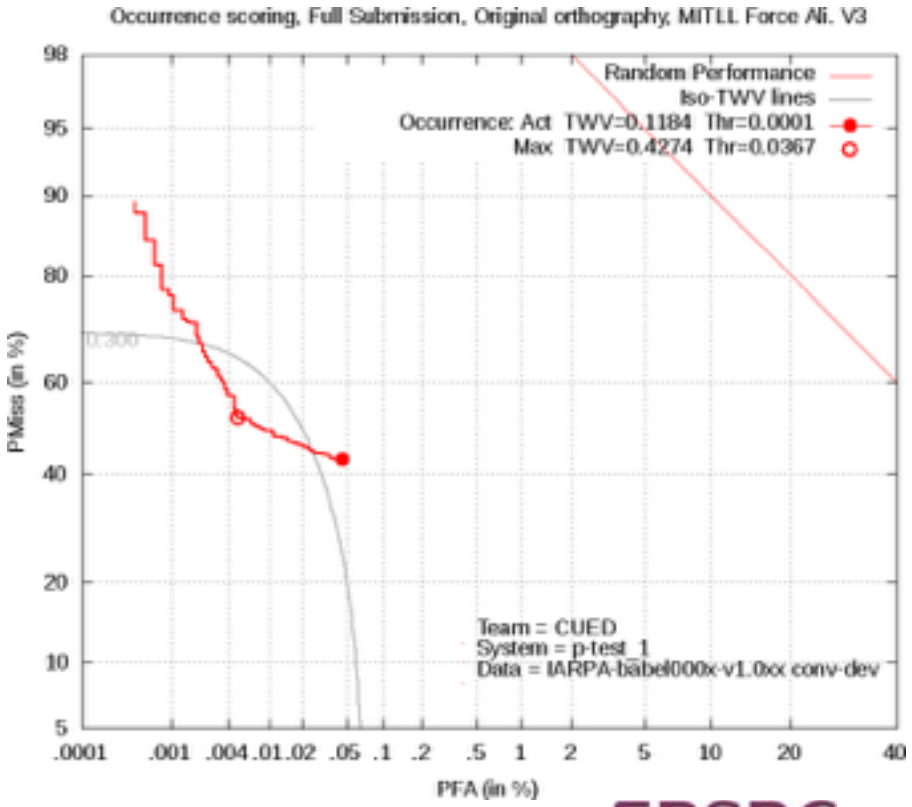


# Duty Calls: adding pronunciations

Recall can be increased to 60% by generating pronunciations for the missing words and searching for them in lattices

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# Conclusions

- ASR can be used as the basis for good browsing tools for Oral History
- Using summaries to tune language models is highly effective
- Keyword Spotting from lattices is also effective

# Future Work

- Adapt acoustic models for individual speakers
- Links between interviews and between collections
- Add value to the summaries