# A Low-Resource Pipeline for Text-to-Speech from Found Data with Application to Scottish Gaelic

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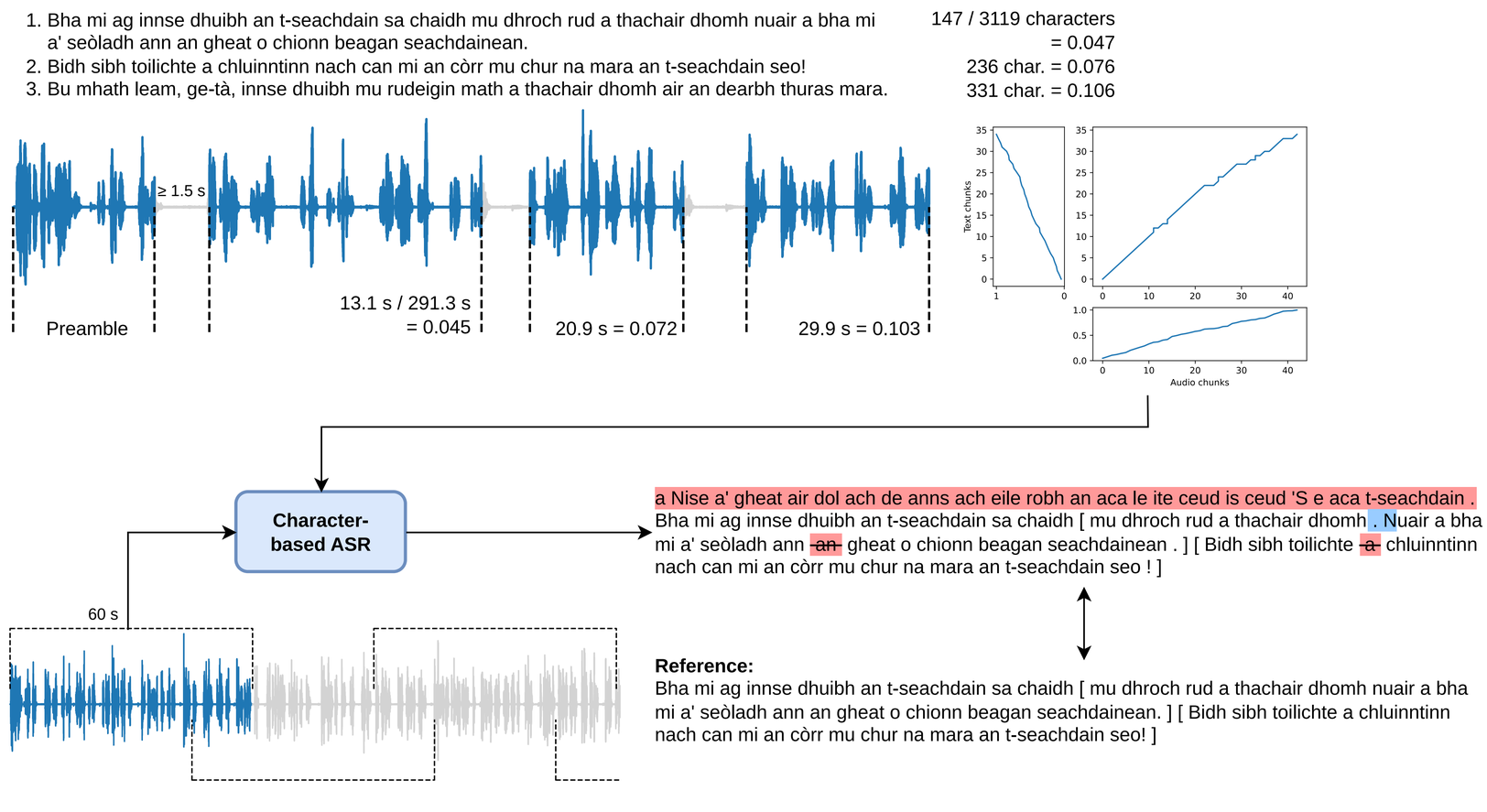
## What kind of linguistic resources do we need for TTS?

- Speech audio segmented at utterance level with text transcripts
  - Assumptions about data requirements reevaluated given more recent non-autoregressive architectures such as FastPitch
  - Increasing use of 'found' data over studio recordings, with some pre-processing
- Linguistic knowledge to process input text and represent the target language symbolically
  - Production systems rely on hand-crafted frontends and pronunciation lexicons
  - Effectiveness of character-input TTS depends on target language orthography

## What do we have for Scottish Gaelic?

- Long history of archival recordings and broadcast media, plus more recent language revitalisation efforts
- Our data comes from the *Litir do Luchd-ionnsachaidh* 'Letter to Learners' series broadcast on *BBC Radio nan Gàidheal*
  - 1,200 recordings, each around 5 minutes, all from a single speaker
  - Full text transcripts, but unsegmented
- Relatively regular orthography, plus *Am Faclair Beag* online dictionary with 35k phonemic pronunciations

## Character-based segmentation and transcript alignment




### Step 1

- Split long recordings on silences over 1.5 s
- Split long transcripts on punctuation
- Roughly align chunks based on cumulative proportions through each sequence
- Train initial acoustic model using character sequences for word pronunciations

### Step 2

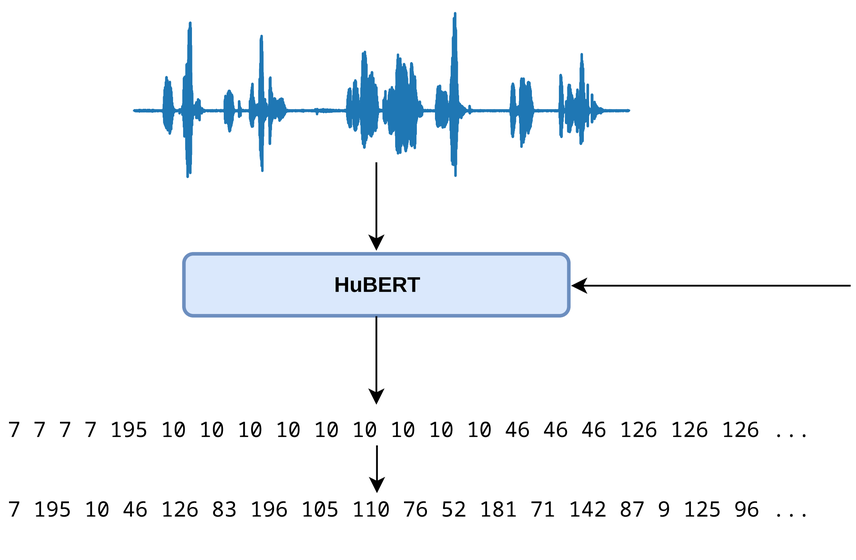
- Decode 60 s chunks of audio with language model trained on full text transcripts
- Smith-Waterman alignment between ASR hypotheses and reference text
- Successfully ignores audio portions not in transcripts, e.g. recording preambles

| Unsegmented | Yield | # Utts |
|---|---|---|
| 100 hours | 86.7 hours | 31,174 |
| 8 hours | 5.5 hours | 1,203 |
| 2 hours | 55 mins | 253 |

## Acoustically-driven data set selection

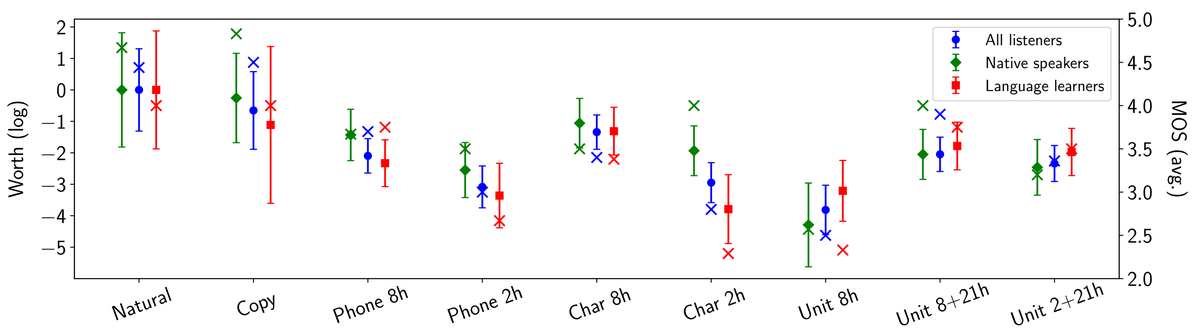
- Aim to maximise phonetic coverage in smaller TTS corpora
- Substitute discrete acoustic units from pre-trained HuBERT (English-only) + Gaelic k-means (200 clusters)
- Greedily select utterances based on unit trigram coverage
  - Achieves 80% of reference triphone coverage for given corpus size

| Data set | # Utts | Triphone coverage | |
|---|---|---|---|
| 2h clean | 475 | 12,376 | 30.2% |
| 8h clean | 2,207 | 22,995 | 56.1% |
| 21h noisy | 7,335 | 24,510 | 59.8% |
| Validation | 380 | 7,412 | 18.1% |
| Test | 418 | 7,112 | 12.4% |




## TTS evaluation

- FastPitch models with different inputs
  - Characters
  - Phones (G2P from *Am Faclair Beag*)
  - Acoustic units (text-to-unit supplemented with noisier recordings)
- Hard to recruit listeners (57k speakers)
  - 3 native speakers
  - 3 'confident/intermediate' language learners
- Best-worst scaling design to compensate for small number of participants




Subjective rankings from best-worst comparisons; crosses indicate average MOS

## Conclusions

- Best-worst scaling and MOS results generally consistent
- Character-based system works well for Gaelic, avoiding effort of building lexical resources and possible G2P errors
- Acoustic unit-based systems seem more consistent when reducing corpus size – perhaps simpler resynthesis task
- Judgements of characters vs. acoustic units different for native speakers and language learners – perhaps reflecting linguistic knowledge vs. audio quality preference

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**Get the code!**

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