New approach to polyglot synthesis: how to speak any language with anyone's voice

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Main goal of this research

- Create a synthesizer that can speak multiple language with the voice of any person, regardless of the language actually spoken by that person.

- Why? An ever growing number of people use 2 or more languages every day.
  - Bilingual countries: China, India, Pakistan, Belgium, Spain, Paraguay, most African countries, most ex-soviet countries,…
  - 47 million people in USA (18% of the population) speak at home a language other than English. (Census 2000)

=>People who need to speak several languages will expect their computers to do it too.

For which applications is useful a polyglot synthesizer?

- Applications where two or more languages are mixed and a voice switch is not appropriate
  - Correct synthesis mix-lingual texts.
    - SOHO是Small Office Home Office的缩写，亦即“小型的、家庭的办公室”的含义。
  - Devices that have to be adapted to work in different languages (e.g. speech-to-speech translators, car-navigation systems)
- Help to preserve endangered languages by reducing the development costs

Previous approaches

- Polyglot speaker database
  [Traber et al. 1999]
  - **Advantages**
    - Unit selection speech quality
  - **Disadvantages**
    - Difficult to find polyglot voice talent
    - Hardly expandable
- Phone-mapping [Campbell 2001]
  - **Advantages**
    - Easy and universal
  - **Disadvantages**
    - Too strong foreign accent reduces the understandability
    - Degraded quality in concatenative synthesis

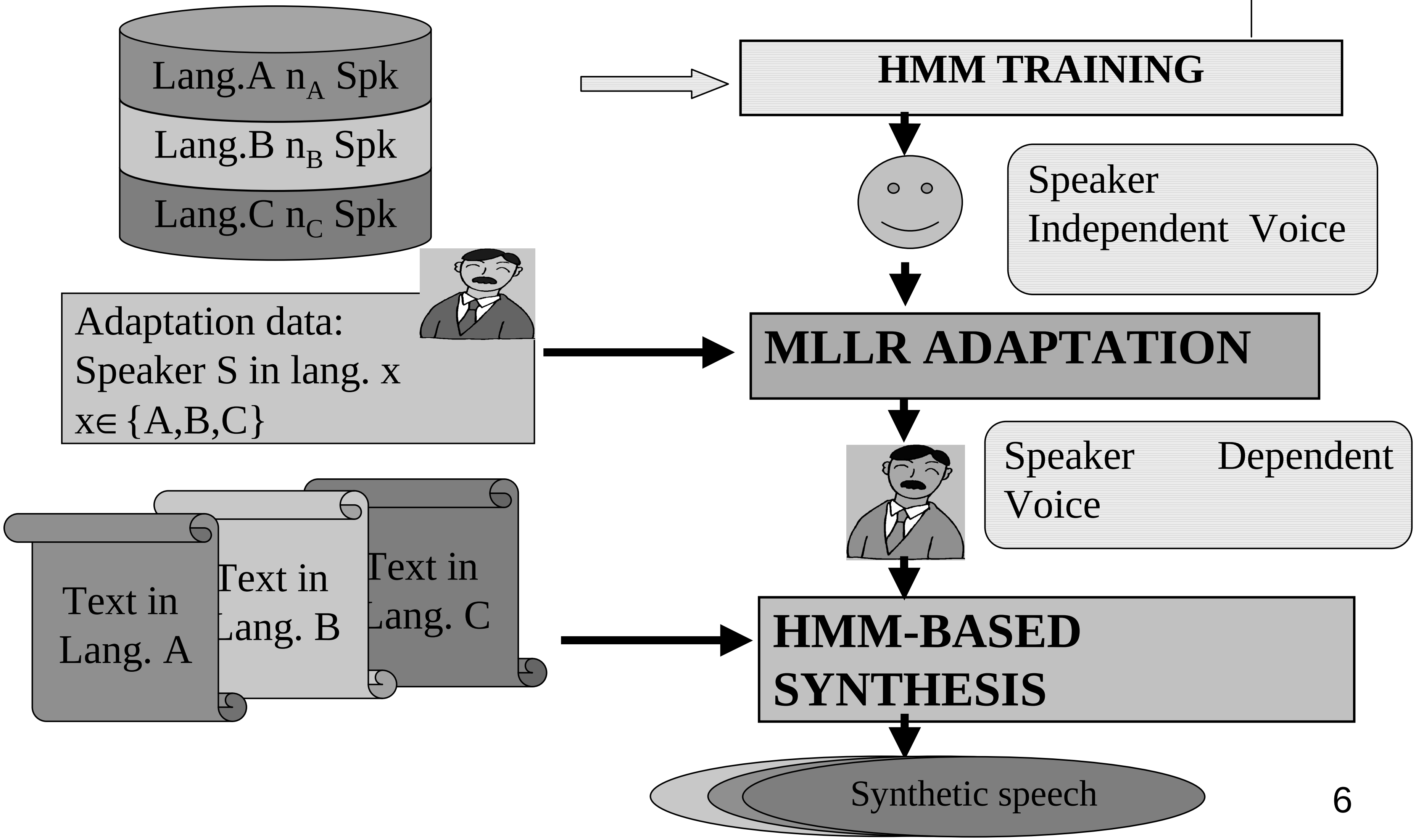
Our approach

- Voice identity depends on anatomical factors.

  ⇒the average voice of any language should sound more or less the same.

- IDEA ⇒ By mixing data from several speakers in several languages, it should be possible to create an “statistical” polyglot speaker!

HMM-based speaker adaptable polyglot synthesizer



Advantages of this approach

- No real polyglot speaker is required, therefore
  - it can be expanded to any new language.
- No phone mapping is needed, therefore
  - the foreign accent is lower and the intelligibility is better.
- It is based on HMM synthesis, so
  - it can be easily adapted to imitate almost any voice,
  - Small footprint (around 4-6MB for 4 languages).

And disadvantages.

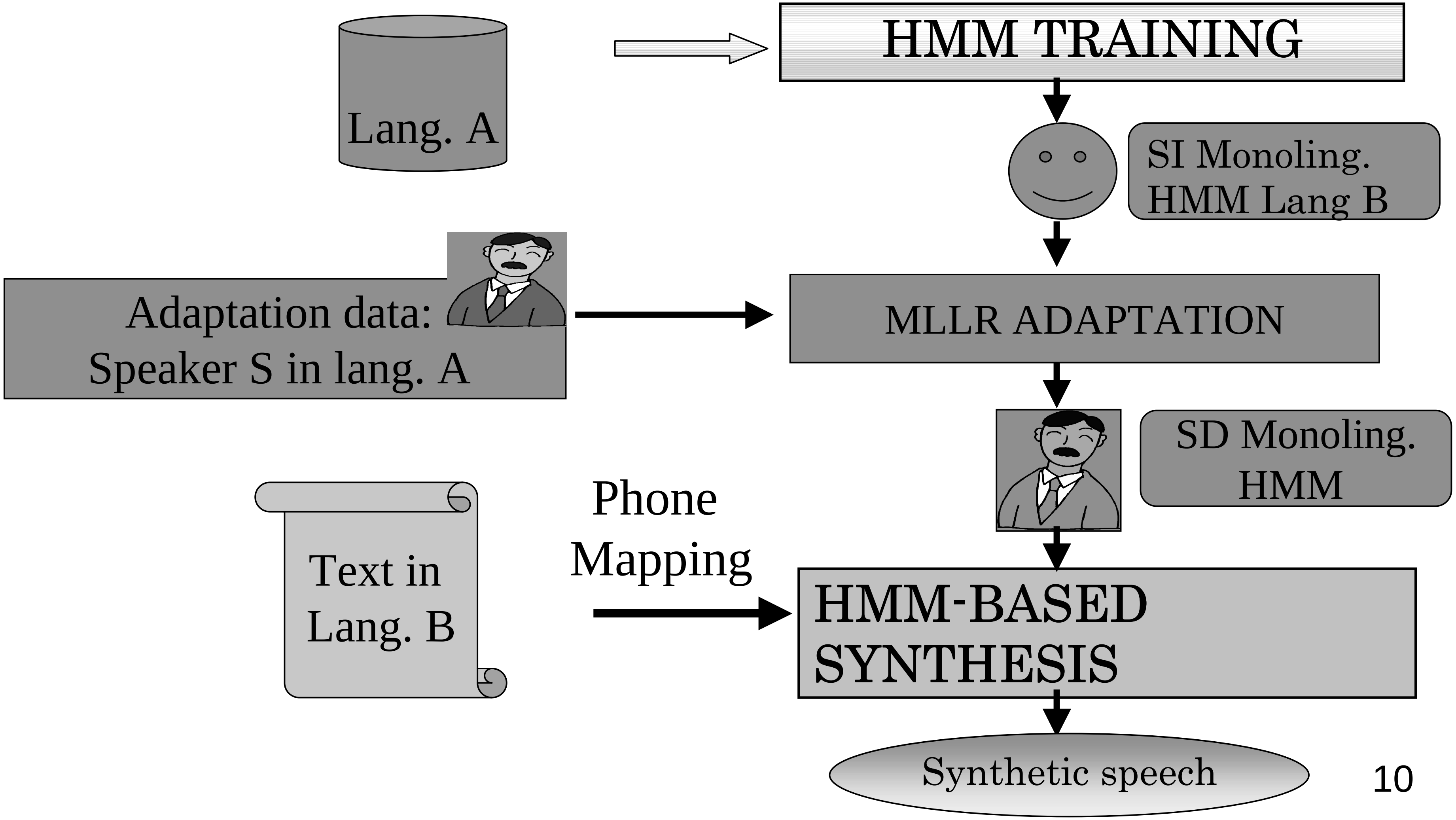
- The audio quality is a telephone-like quality as in any HMM-based synthesizer.
- However,
  - HMM-synthesis can provide better quality than any other synthesis method when the amount of training data is below 50 min [Bennet 2005].

Evaluation (I)

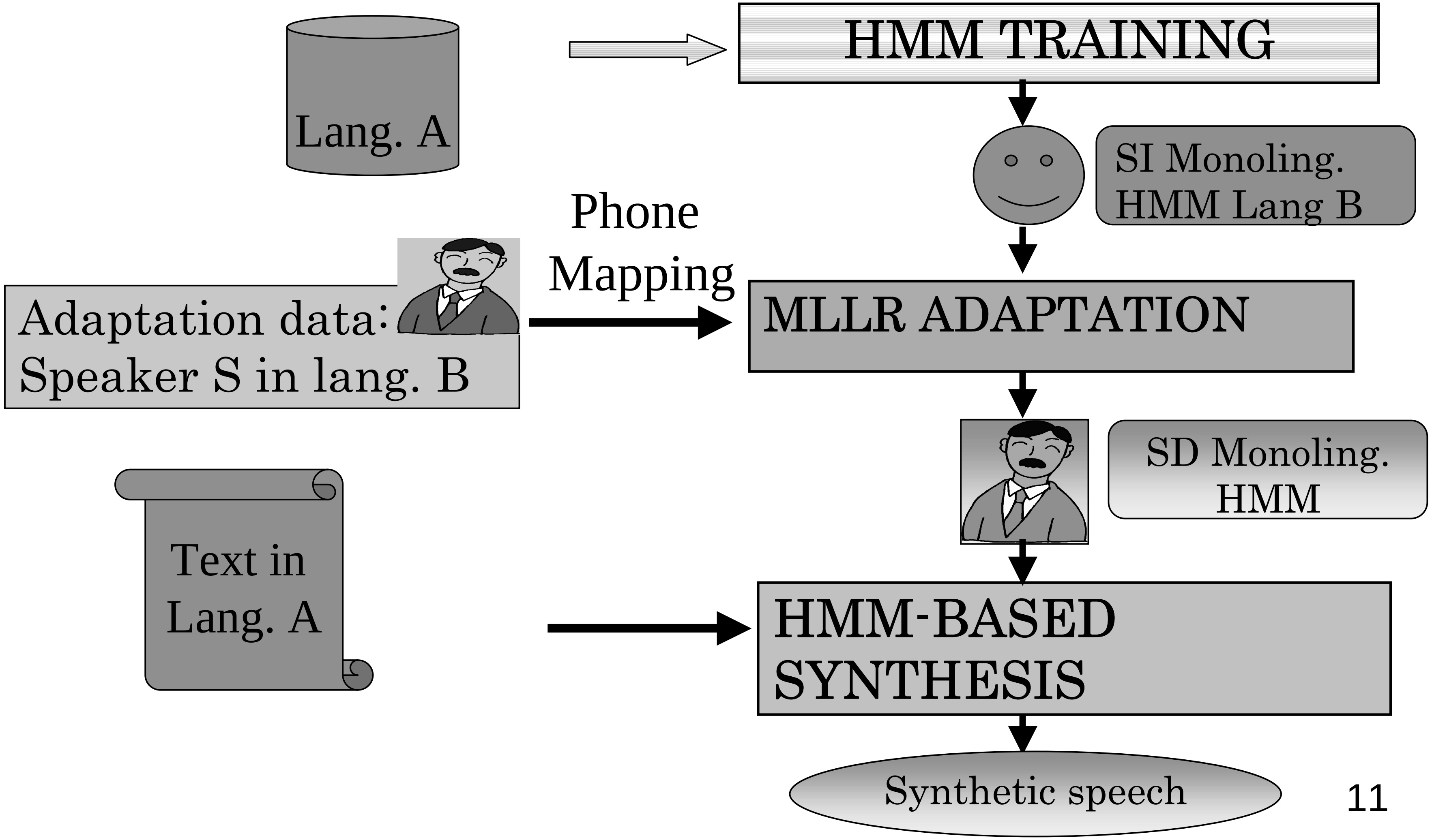
- Compare our method with others based on phone mapping to:
  - Synthesizing the target language with a synthesizer trained in the language of the target speaker.
  - Adapting a synthesizer trained in the target language to the voice of the target speaker.

- We have evaluated the performance of our method according to 3 parameters
  - Perceptual Intelligibility
  - Native accent
  - Similarity to the target speaker

Cross-language synthesis using phone mapping



Cross-language speaker adaptation using phone mapping



Evaluation (II)

- We have considered three different scenarios:
  - Cross-language synthesis: The language spoken by the target speaker and the language to be synthesized are different but included in the training data of the polyglot model.
  - Synthesis of extrinsic languages: The language to be synthesized is not included in the training data.
  - Direct synthesis: The language spoken by the target speaker and the language to be synthesized are the same (and included in the training data)

Experimental conditions

- Evaluation method: Subjective evaluation in a 5 points MOS scale.
- Evaluation Language: Spanish and Japanese.
- Subjects: 6 native speaker for each evaluated language.
- Languages used to train the synthesizers: Different combinations of Russian, French, German, Spanish and Japanese.
- Models adapted to two target voice for each language included in the mixture: 66 SD models.
- Test sentences: 18 different sentence synthesized by each SD acoustic models.

System Details

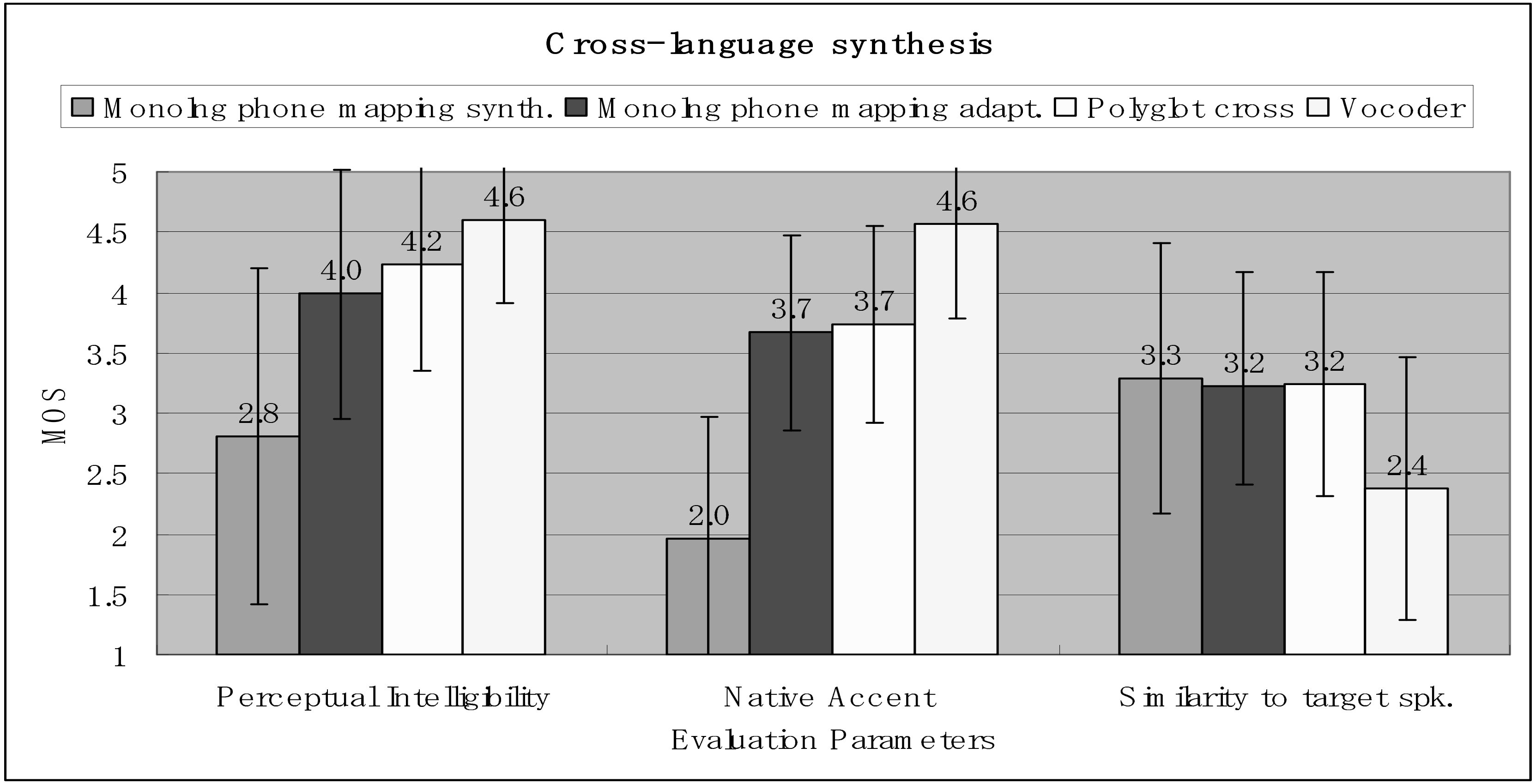
- Speech Data:
  - Globalphone, general purpose databases
  - Training data: 10 speakers for each fully included language with ~10 minutes of data for each speaker
  - Adaptation data: 10 minutes of data for each target voice.

- Models:
  - Triphone HMMs, 3 states ,1 Gaussian.
  - 25 MELC and their delta from a 16ms window.
  - Single root tree clustering.
  - The models were adapted to the target voices with supervised MLLR using 4 adaptation classes.

- Original prosody (f0 and duration) from the audio version of the test texts.

Cross-language synthesis scenario

The language spoken by the target speaker and the language to be synthesized are different.

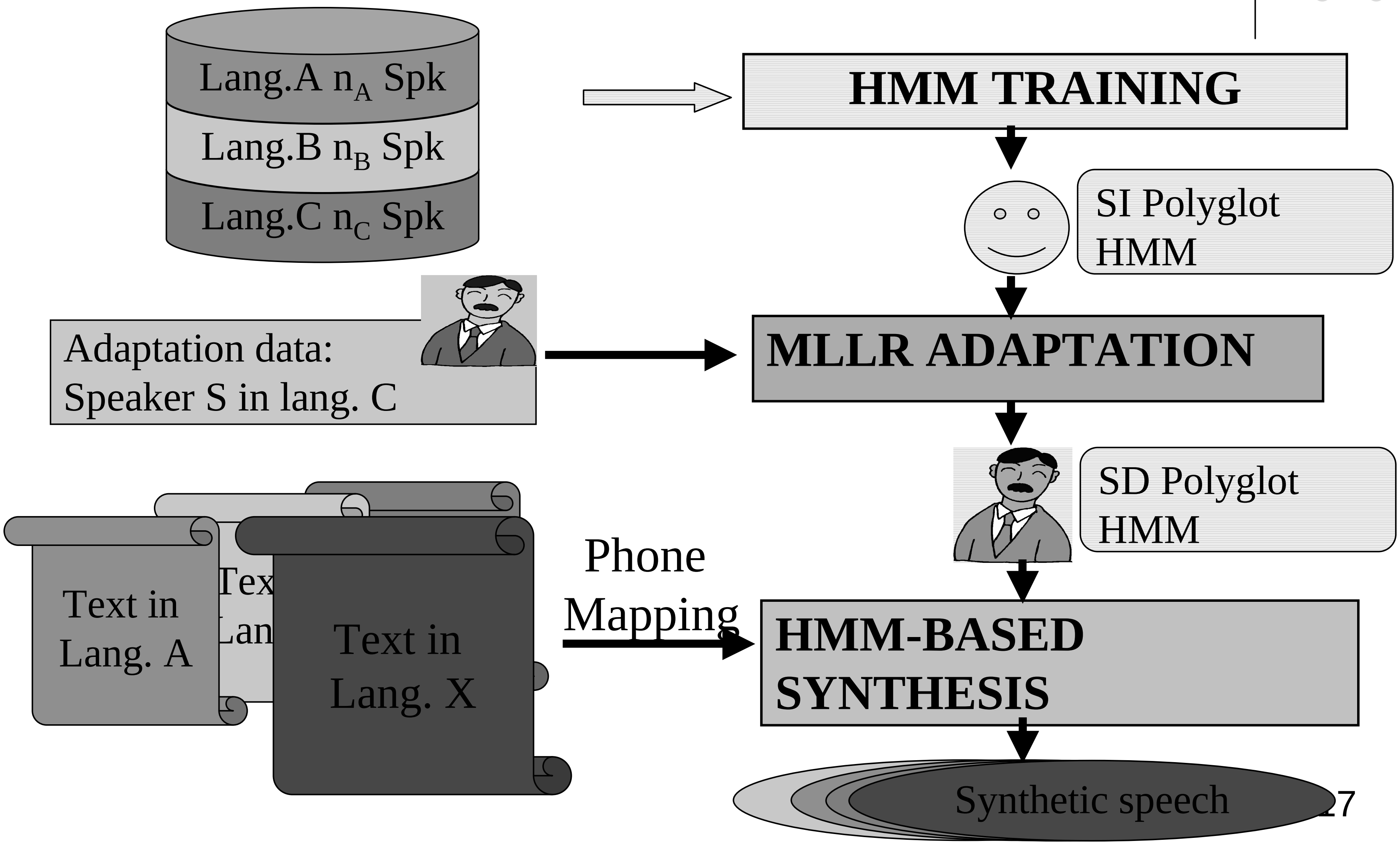


Synthesis of extrinsic languages

- To create a speech synthesizer for a new language is a very expensive task, only profitable for a dozen or so languages.

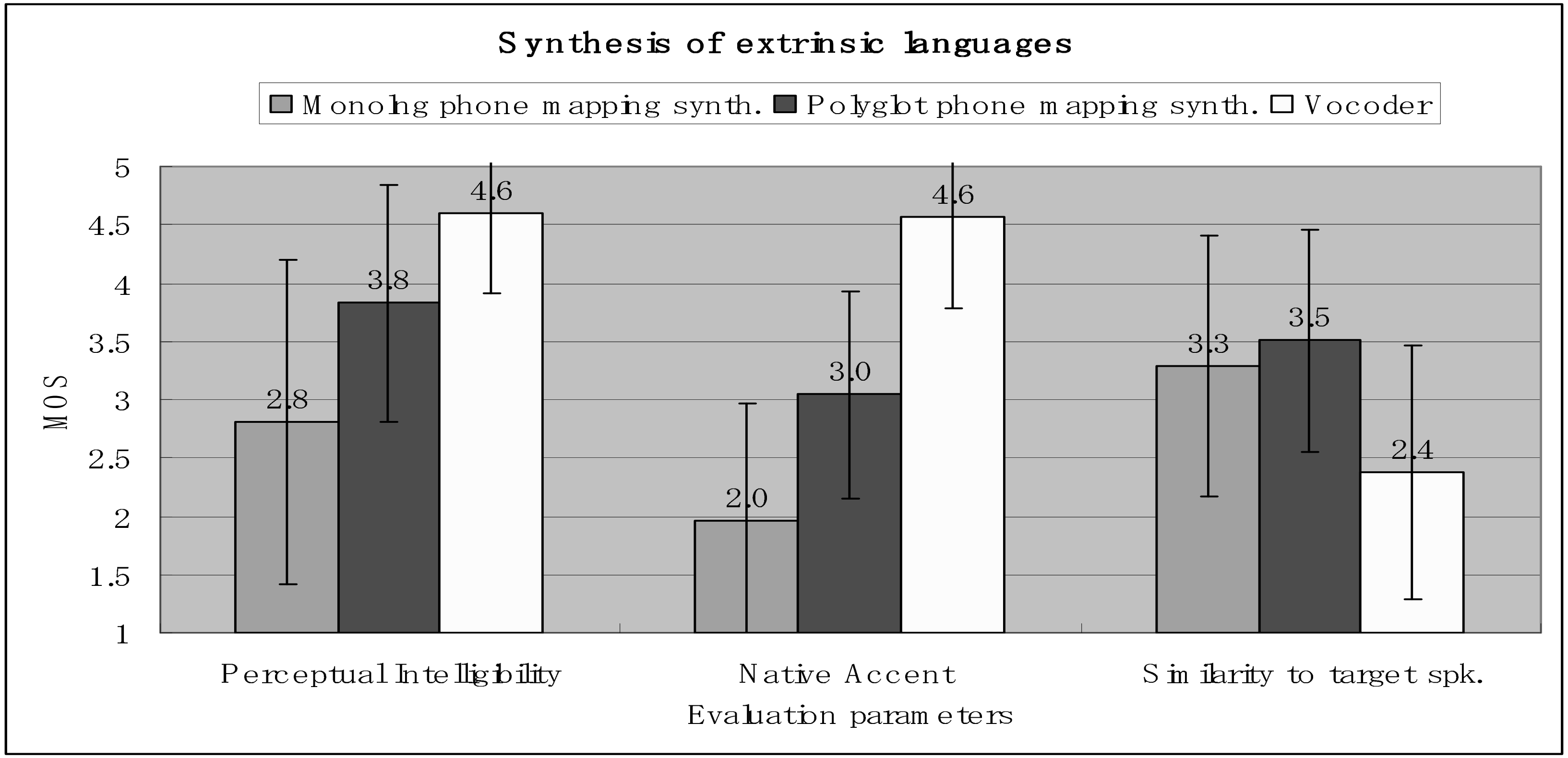
- For minority language a possible solution is to use speech resources which are available from a phonetically similar language.

Synthesis of extrinsic languages with a polyglot synthesizer

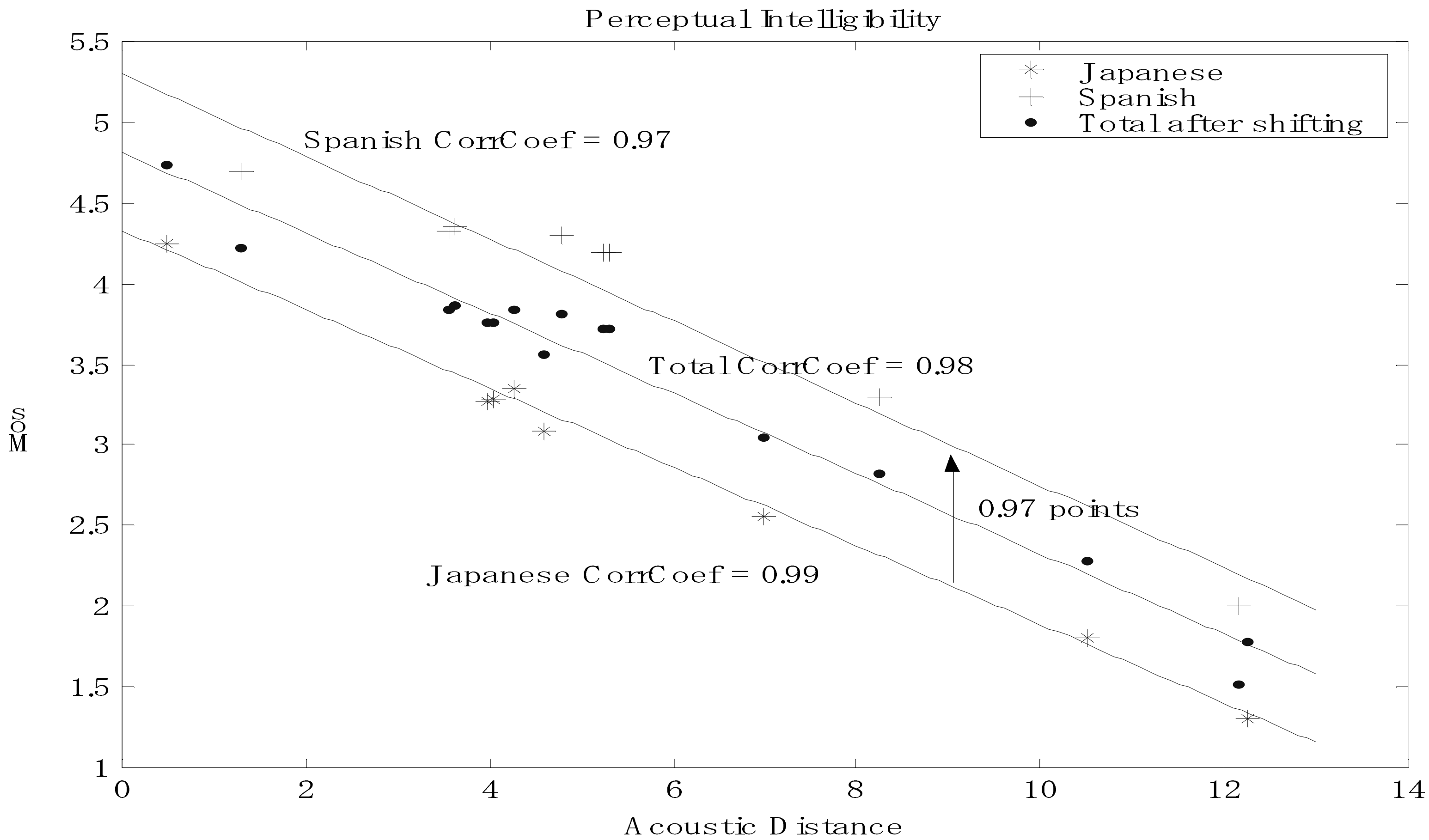


Synthesis of extrinsic languages scenario

The language to be synthesized is not included in the training data.

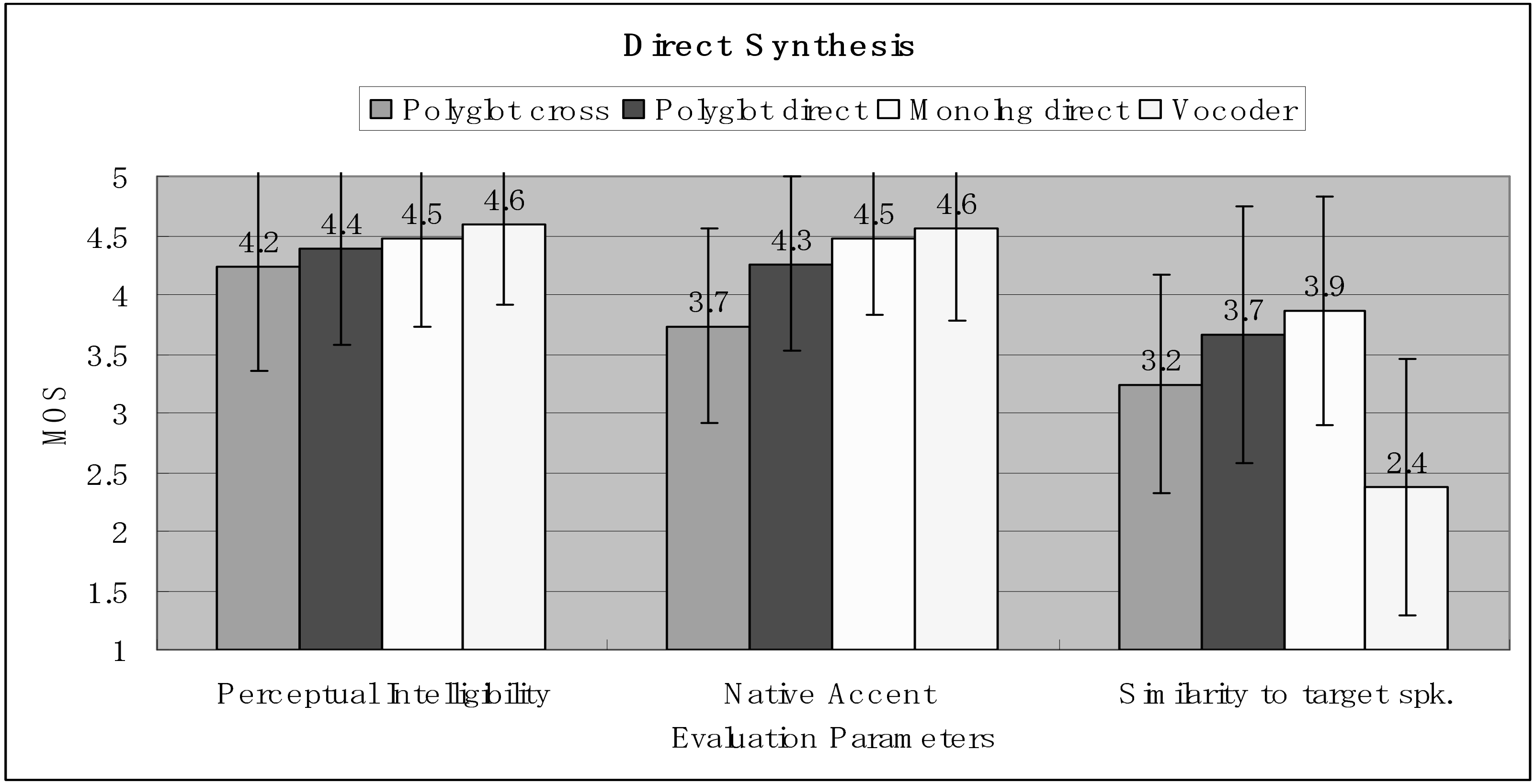


Perceptual intelligibility vs acoustic distance



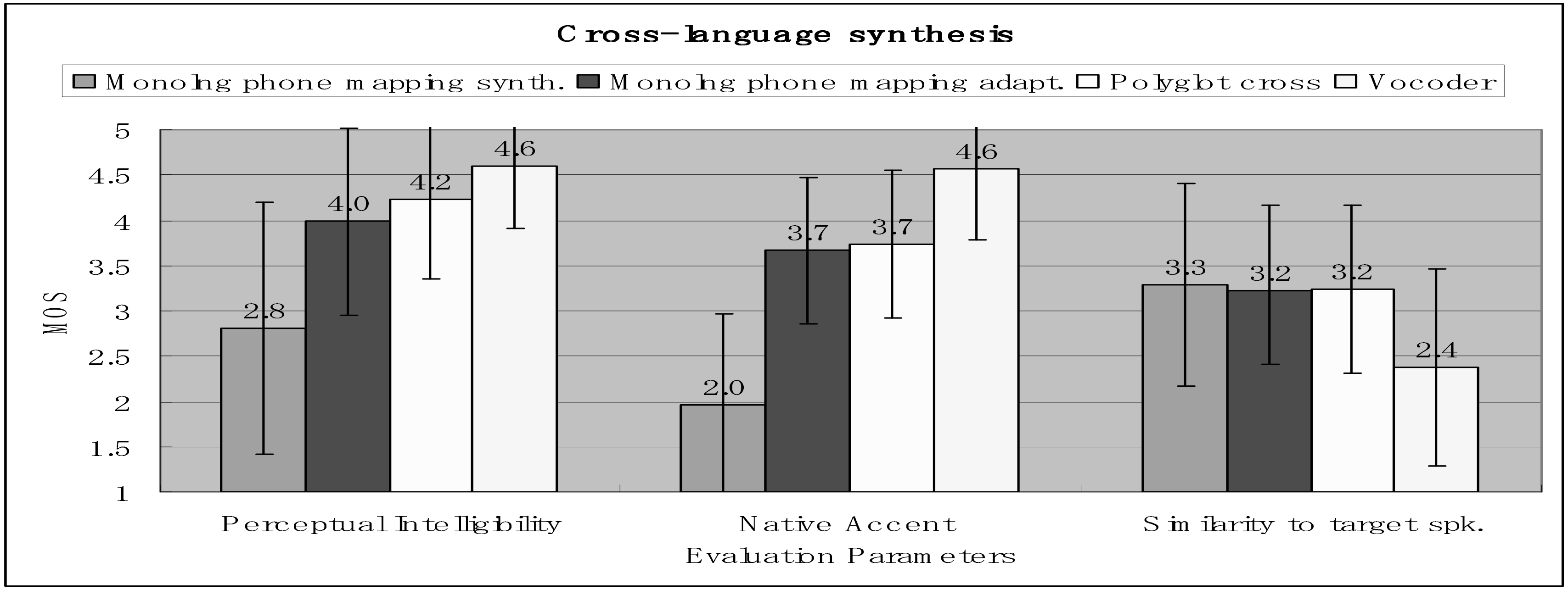
Direct synthesis scenario

The language spoken by the target speaker and the language to be synthesized are the same.



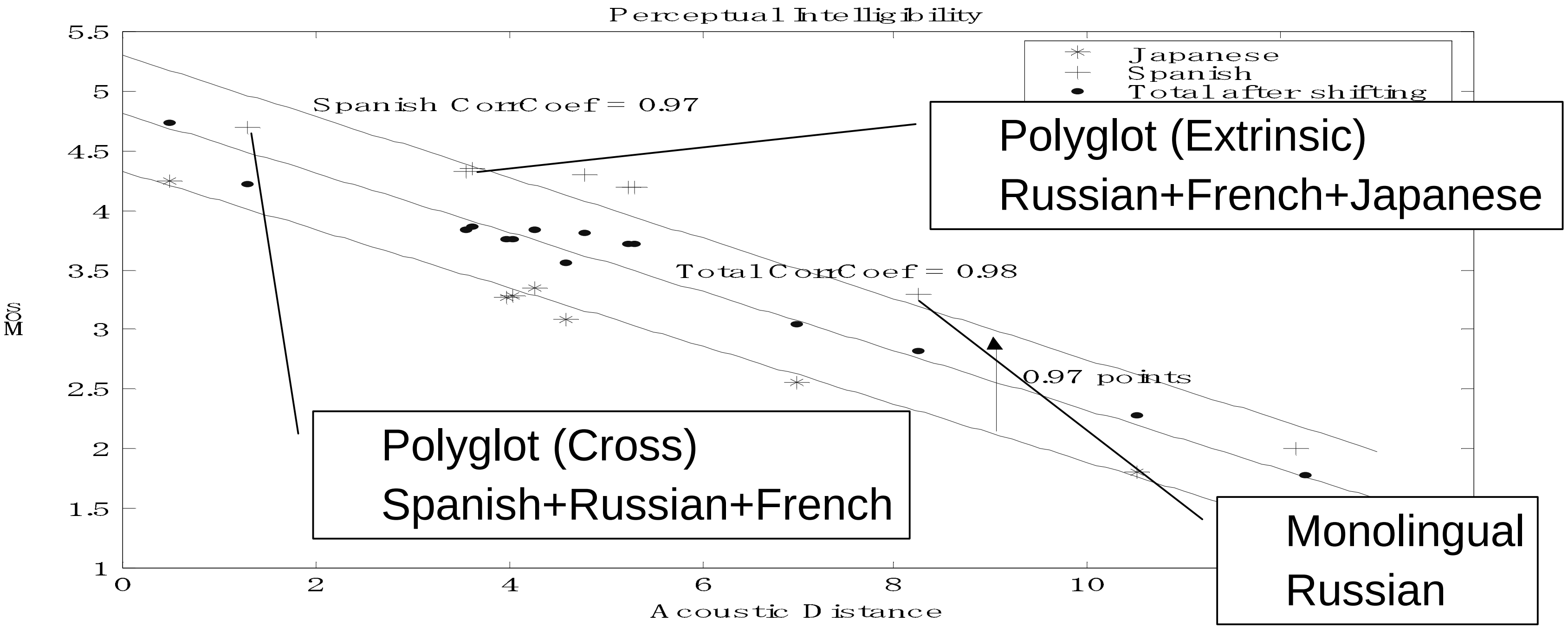
Demo cross-language

- El pasado lunes fue el dia de los trabajadores en Estados Unidos 新党　準備会実行委員長を務める tradicionalmente se señala 小沢代表幹事の周辺は



Demo extrinsic languages

- La consigna de los seguidores del nazismo, se llamaba colaboracionismo, esto es el apoyo activo a una potencia de ocupacion enemiga.



Conclusions

- It is possible to create a polyglot synthesis by mixing corpora of different languages.

- The performance of a polyglot synthesizer is better than methods based on phone-mapping when
  - A) the language of the speaker is different than the language that is synthesized (Cross-language synthesis).
  - B) there is no available speech data from language to be synthesized, (synthesis of extrinsic languages).

- In the normal case, the performance of the polyglot synthesizer is equivalent to that of a standard monolingual synthesizer in that language

Next steps

A) Improve the audio quality: GV, HNM, trajectory HMM, etc.

B) Improve the speaker adaptation: SAT, SMLLR

C) Test the amount of speech data needed to synthesize a new language with the same performance as the languages previously included.

- Check which approach can be applied to the prosody.

Thank you very much for your attention