Development of a BOSS unit selection module for tone languages
Exemplification in Ibibio

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6th ISCA Workshop on Speech Synthesis
23rd August 2007
Ibibio corpus sample / synthesis

/ana ekop dumpem odo khi ke ifun omm uwm/

Synthesized
Ibibio
Nigeria
Ibibio

State map
Ibibio Tones

- High H
- Downstepped high D (!H)
- Low L
- Rising R (LH)
- Falling F (HL)
Ibibio
Tonal contrasts

óbóŋ  mosquito
óbòŋ  cane

sé  look
áà-sèè-hè  one who looks
áà-!ké-séé-hé  one who looked
áà-!dî-sé  one who will look
Ibibio
Start-up effect

<table>
<thead>
<tr>
<th>Pitch (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>200</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>400</td>
</tr>
<tr>
<td>500</td>
</tr>
</tbody>
</table>

#owo ibarakikaN ikeene daNa udVvikOt OJOON#

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>0.95</th>
<th>2.67</th>
</tr>
</thead>
</table>

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BOSS-IBB
### Ibibio Downdrift

<table>
<thead>
<tr>
<th>Pitch (Hz)</th>
<th>0</th>
<th>100</th>
<th>200</th>
<th>300</th>
<th>400</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (s)</td>
<td>1.03</td>
<td>2.76</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>dOkto desi widisin</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>P</td>
</tr>
<tr>
<td>$p$</td>
</tr>
<tr>
<td>P</td>
</tr>
<tr>
<td>$p$</td>
</tr>
</tbody>
</table>

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BOSS
Bonn Open Synthesis System

- BOSS source code: sourceforge.net/projects/boss-synth
- BOSS website: www.ikp.uni-bonn.de/boss/
Goals

▶ Adaptability
▶ Extensibility
▶ Simplicity
▶ Universality
Goals

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- Extensibility
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Goals

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Stylization of F0

Linear model
Stylization of F0

Representing syllable contours by quartic polynomials

<table>
<thead>
<tr>
<th>Time (s)</th>
<th>0.518073</th>
<th>3.67064</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch (Hz)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

H H H H L H F H H P H L L L P

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Stylization of F0

Basic value data representation

\[ f(x) = 2x^4 - 3x^2 + 0.6 \]
Vector quantization
Vector quantization

Code vectors 32 - 47 out of 64
Prediction

Requirements
Prediction

Most important parameters of a test tree

- Position of the syllable in the phrase
- Position of the word in the phrase
- Number of phones in the syllable
- Syllable structure (e.g. C, V, N)
- 4th left neighbouring tone
- Remaining
Prediction

Most important parameters of a test tree

- Position of the syllable in the phrase
- Position of the word in the phrase
- Number of phones in the syllable
- Syllable structure
- 4\textsuperscript{th} left neighbouring tone
- Remaining

- 62.96\%
- .
- .
- 67.82\%
- 71.89\%
Prediction

Example from CART

```lisp
((sylphrase < 15.7)
 ((sylphrase < 8)
   ((sylphrase < 3.4)
     ((ltone2 is P)
      (ltone1 is P)
      ((phonessyl < 1.3)
       (50)
       (53)
       (50)
     ((f < 0.1)
      ((wordphrase < 1.2)
       (45)
       (catsylword is i)
       (45)
       (50)))))
)```

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Prediction
Tone template classification

On 10 different test sets (10 % held-out data):

- Correct code vectors (out of 64):
  - 38.55 % - 59.04 %

- Correct code vector classes (out of 16 in second codebook):
  - 42.77 % - 68.07 %
Unit selection
To do

- Get hold of a bigger corpus
- Perform subjective listening tests
- Adapt the module to another tone language
- Try the approach for an accent language
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Thank you!