A Strategy for Correcting Errors in Automated Formant Extraction

Lisa M. Johnson
Brigham Young University - Provo, lisamorganjohnson@byu.edu

Follow this and additional works at: https://scholarsarchive.byu.edu/facpub

Part of the Linguistics Commons

Original Publication Citation

BYU ScholarsArchive Citation
https://scholarsarchive.byu.edu/facpub/5685

This Poster is brought to you for free and open access by BYU ScholarsArchive. It has been accepted for inclusion in Faculty Publications by an authorized administrator of BYU ScholarsArchive. For more information, please contact ellen_amatangelo@byu.edu.
BACKGROUND

- Sociolinguistic vowel analysis relies heavily on first and second formant estimates (F1 and F2) (e.g., Labov, Yaeger, & Steiner, 1972).
- Linear Predictive Coding (LPC) algorithms and automated extraction techniques speed up data collection and make possible the use of large data sets.
- However, LPC algorithms are prone to certain errors (e.g., Di Paolo, Yaeger-Dror, & Wassink, 2011; Harrison, 2013; Labov, Ash, & Bobberg, 2006; Strelluf, 2019; Styler, 2017).
- “Faulty low F2” (FLF2) error occurs when the software finds a spectral peak between F1 and F2 and labels it as F2.
- Manual correction is time-consuming, and simply discarding outliers removes valuable data from the analysis.

DATA

- Word list tokens from recordings of Utah teens - stressed BEET, BIT, BET, BAT, BOOT, BOOK, BUT, and BOAT vowels before obstruents.
- Praat TextGrids created through forced alignment with Montreal Forced Aligner (McAlufie, et al., 2017).
- F1-F3 estimates extracted at 7 points from 20% to 80% of vowel duration, using R script, PraatR (Albin, 2014) and Praat (Boersma, 2001) - max formant at 5000 for males and 5500 for females.

METHODS

Use R script to detect possible FLF2 errors and make corrections.

**FLF2 Error Detection**

- Identify F2 measurements at 20% of duration that fall outside an expected range, defined by an upper bound and lower bound for each vowel.
- Identify abrupt, large drops in F2 between successive measurement points, based on a predetermined drop value for each vowel.

**FLF2 Error Correction**

- Where a possible FLF2 is detected, determine whether the recorded “F3” estimate falls within an expected F2 range for the vowel.
- Substitute the recorded “F3” measurement for the recorded “F2” where appropriate.

RESULTS

Summary of Checks and Substitutions

<table>
<thead>
<tr>
<th>Vowel Class</th>
<th># of Tokens</th>
<th># of Estimates Checked</th>
<th># of Subs Made</th>
<th># of Low F2 w/o Sub</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEET</td>
<td>787</td>
<td>5509</td>
<td>1283</td>
<td>32</td>
</tr>
<tr>
<td>BIT</td>
<td>896</td>
<td>6272</td>
<td>431</td>
<td>105</td>
</tr>
<tr>
<td>BAIT</td>
<td>1367</td>
<td>9569</td>
<td>391</td>
<td>21</td>
</tr>
<tr>
<td>BET</td>
<td>1122</td>
<td>7854</td>
<td>263</td>
<td>15</td>
</tr>
<tr>
<td>BAT</td>
<td>1052</td>
<td>7364</td>
<td>183</td>
<td>236</td>
</tr>
<tr>
<td>BOAT</td>
<td>374</td>
<td>2618</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>BOOK</td>
<td>806</td>
<td>5642</td>
<td>83</td>
<td>29</td>
</tr>
<tr>
<td>BOAT</td>
<td>759</td>
<td>5313</td>
<td>3</td>
<td>40</td>
</tr>
</tbody>
</table>

- 55,398 measurements checked (7,914 tokens; 7 measurements per token).
- Highest numbers of possible errors in vowels with large difference between F1 and F2 (high front vowels).
- Script efficacy tested through random check (3% sample of low F2 measurements from 2 focal groups; Euro American and Pacific Islander Americans; N=104).
- Script performed well in 79% of cases, produced an error in 5%. (In 16% files were problematic in some way - needed to be discarded or remeasured).

CONCLUSIONS & IMPLICATIONS

- Correction process dramatically reduces the number of outliers to be manually checked, saving hundreds of hours.
- Researchers can focus attention on other potential problems that require human judgment.
- Because legitimate outliers are not simply discarded, real variation can be investigated.
- Process is replicable, less subject to human error.

**Results of Manual Outlier Check (After Corrections)**

<table>
<thead>
<tr>
<th>Evaluation Category</th>
<th>Count</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remeasure</td>
<td>74</td>
<td>17%</td>
</tr>
<tr>
<td>Discard</td>
<td>139</td>
<td>32%</td>
</tr>
<tr>
<td>Keep</td>
<td>222</td>
<td>51%</td>
</tr>
</tbody>
</table>

ACKNOWLEDGEMENTS

Special thanks to participants, faculty, and administrators at Valley View and Lakeside High Schools.

Thanks to Marianna Di Paolo, Adrian Bell, Brian Codding, Elizabeth Cashdan, Katie Drager.

This material is based upon work supported by the National Science Foundation under Grant Number BCS-1749582.