RHYTHM AND MELODY IN WRITTEN LANGUAGE

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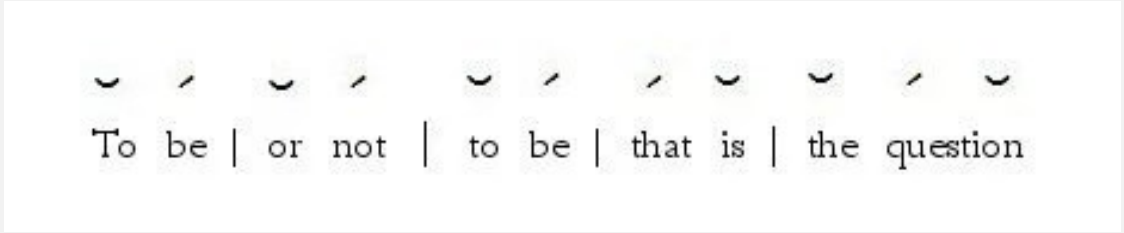
MOTIVATION

- Some texts have a defined rhythmic pattern:
  - Shakespeare's iambic pentameter
  - Homer's dactylic hexameter
- Do other genres also have rhythm and melody?
  - Novels
  - News articles
  - Academic writing



A LITTLE BIT OF INTUITION

"In this paper, the problem of pedestrian egress under different geometries is studied by means of two numerical models."

"There was a Young Lady whose chin Resembled the point of a pin..."

"I took a deep breath and listened to the old brag of my heart; I am, I am, I am."

"This sentence has five words. Here are five more words. Five-word sentences are fine. But several together become monotonous…

Now listen. I vary the sentence length, and I create music. ***Music. The writing sings. It has a pleasant rhythm, a lilt, a harmony.*** I use short sentences. And I use sentences of medium length. And sometimes when I am certain the reader is rested, I will engage him with a sentence of considerable length, a sentence that burns with energy and builds with all the impetus of a crescendo, the roll of the drums, the crash of the cymbals—sounds that say listen to this, it is important.

… Don't just write words. Write Music."

-Gary Provost

QUESTIONS

1. Do different genres of writing "*sound*" different? Can we quantify that?
   - Creative vs. Academic writing

2. Can we use the "sound" of a text to identify its genre?

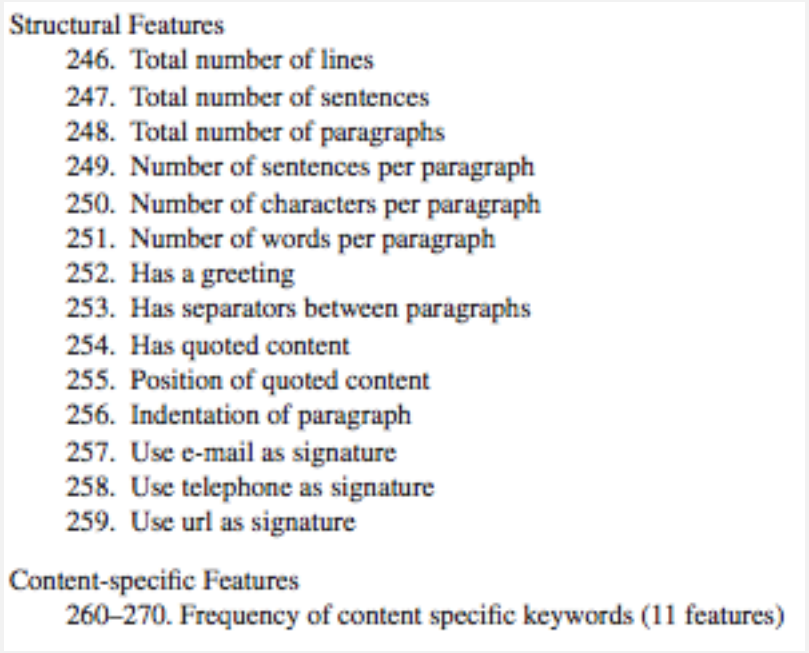
PREVIOUS WORK

A Framework for Authorship Identification of Online Messages: Writing-Style Features and Classification Techniques – Zheng et al.

- Measures four types of features:
  1. Lexical
  2. Syntactic
  3. Structural
  4. Content-Specific

Total of 270 features!

Can we simplify this?



Structural Features

246. Total number of lines
247. Total number of sentences
248. Total number of paragraphs
249. Number of sentences per paragraph
250. Number of characters per paragraph
251. Number of words per paragraph
252. Has a greeting
253. Has separators between paragraphs
254. Has quoted content
255. Position of quoted content
256. Indentation of paragraph
257. Use e-mail as signature
258. Use telephone as signature
259. Use url as signature

Content-specific Features

260–270. Frequency of content specific keywords (11 features)

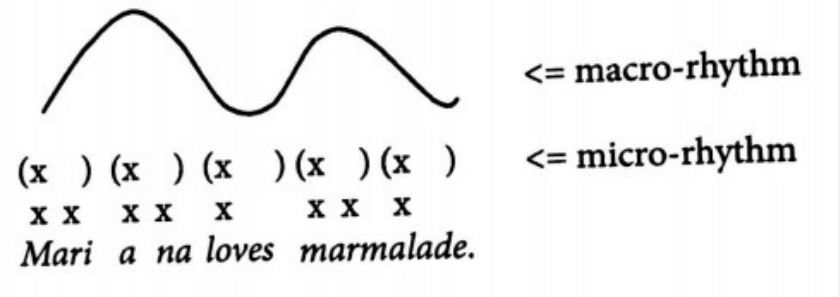
QUANTIFYING "SOUND"

1. **Micro-rhythm**: Regular alternation of strong & weak beats
   - Split sentences by stresses → evenly spaced feet

We're / áll in / túitively fa / míliar with the i / déa of a de / rívative.

2. **Macro-rhythm**: Regular alternation of high & low tones (pitch)
   - Proposed by Sun-Ah Jun
   - Split by H/L tonal sequences → evenly-spaced hills

3. **Melody**: Variation throughout the text



MICRO-RHYTHM: PROCESS

Goal: Split text by syllable prominence (pitch, duration, intensity)

Step 1: Use CMU Pronunciation Dictionary for baseline

- Lots of false positives! – CMU based on word pronounced in isolation
- In reality, intonation based on context.

```
“derivative”
D ER0 IH1 V AH0 T IH0 V
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```
Shall I compare thee to a summer's day
SH AE1 L / AY1 / K AH0 M P EH1 R / DH IY1
/ T UW1 / AH0 / S AH1 M ER0 Z / D EY1

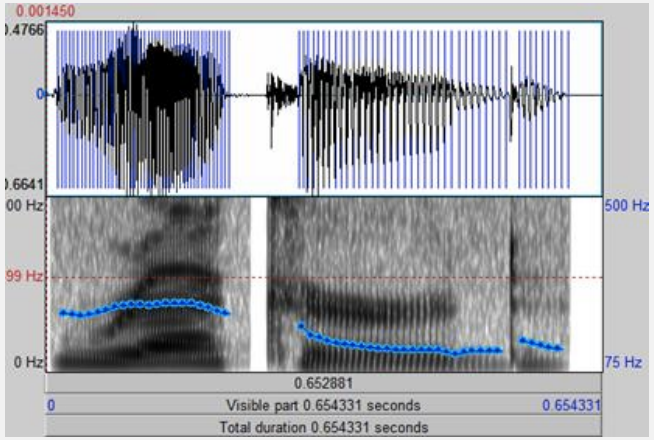
Thou art more lovely and more temperate
DH AW1 / AA1 R T / M AO1 R / L AH1 V L IY0
/ AH0 N D / M AO1 R / T EH1 M P R AH0 T
```

MICRO-RHYTHM: PROCESS

Goal: Split text by syllable prominence (pitch, duration, intensity)

Step 2: Look at audio waveform to refine

- Amazon Text-To-Speech
- Gentle Aligner
- Praat



Syllable	Hz	dB	s	score
"Thou_EH1"	[165.82,	72.58,	.15]	.96
"Art_AA1"	[171.86,	71.55,	.01]	.15
"More_A01"	[153.77,	73.47,	.08]	.54
"Lovely_AH1"	[171.78,	70.07,	.07]	.54
"Lovely_IY0"	[135.86,	71.84,	.08]	.46
"And_AE0"	[132.09,	70.20,	.04]	.18
"More_A01"	[153.87,	72.63,	.07]	.46
"Temperate_EH1"	[125.92,	71.92,	.09]	.54
“Temperate_AH0"	[123.13,	68.93,	.10]	.50

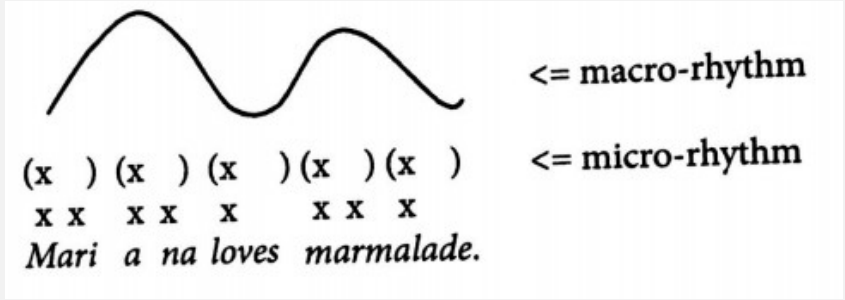
MACRO-RHYTHM: PROCESS

Goal: Split text by pitch contour patterns (high/low slopes)

Definition: ”perceived rhythm based on regular pitch movement”

Text is more macro-rhythmic if:

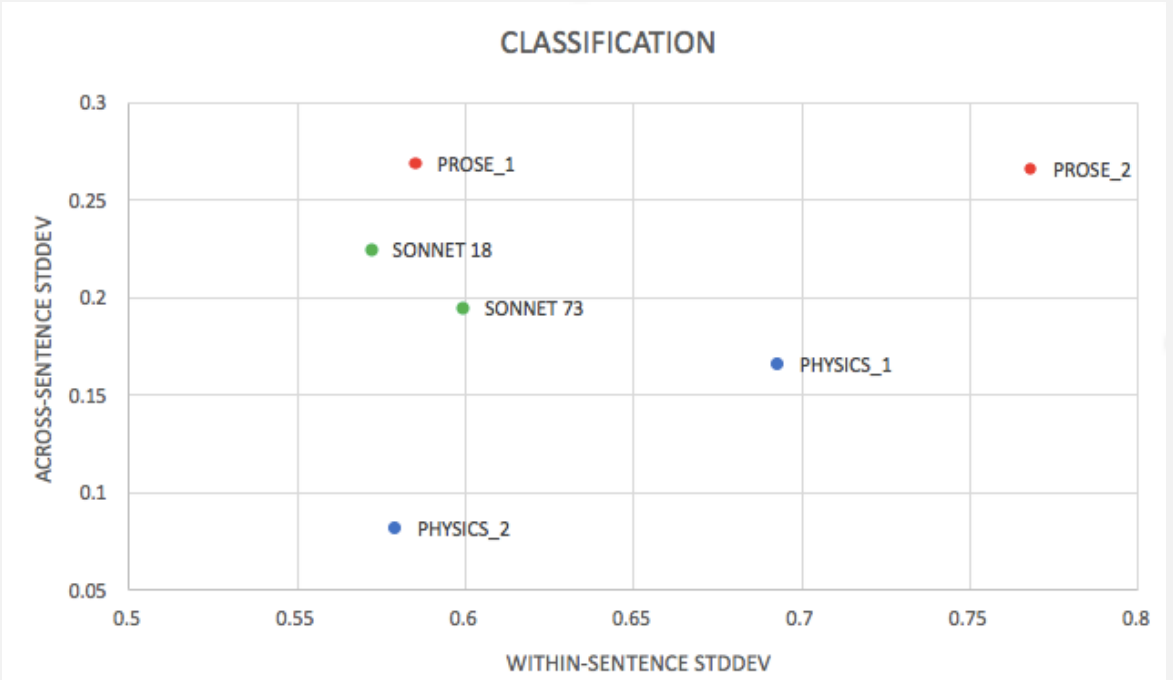
- It has more sequences of rise-fall hills
  - HHHH < HLHLL
- The rise-fall hills are shaped similarly to each other
- The rise-fall hills occur at regular time intervals



RESULTS

- Per-sentence rhythmicity vs across-sentence rhythmicity

	STDDEV	SCALED	STDDEV-MEANS	SCALED-MEANS
PHYSICS_1	0.1925	0.6926	0.0462	0.1662
PHYSICS_2	0.1669	0.5791	0.0235	0.0817
SONNET 18	0.1004	0.5718	0.03950	0.2247
SONNET 73	0.0991	0.5992	0.0322	0.1950
PROSE_1	0.1155	0.5849	0.0531	0.2688
PROSE_2	0.1617	0.7681	0.0560	0.2661



WORK REMAINING

- Complete analysis of macro-rhythm
- Run algorithms on bigger datasets
- Set up classification mechanism - SVM

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