

Timo Baumann
 Universität Hamburg • Department of Informatics
 Natural Language Systems group

Burkhard Meyer-Sickendiek
 Freie Universität Berlin
 Department of Literary Studies

Large-scale Analysis of Spoken Free-verse Poetry

ABSTRACT:

Modern poetry has developed *free-verse prosody*: a post-metrical lyrical prosody that employs rhythmical features of everyday language.

We plan to analyze free-verse prosody using *large corpora* of modern and post-modern poetry in both their *written form* and *as spoken aloud* by the author *combining the strengths of humans and machines*, namely deep understanding and broad coverage.

We use *standard language and speech processing tools* in order to align text and speech, to generate a *null-model* of how a poem would be read by a naïve reader, and to extract *contrastive features used by the poet*.

This paper: proof-of-concept of the methodology using small amounts of data and small feature set (limited to ToBI [1]).

Full project: use methodology to iteratively build prosody models using machine learning that is extended and validated using a *human-in-the-loop* approach.

The Prosody of Free-verse Poetry

- new rhythmical features replace traditional meter
- new interplay of line and stanza: length, integrity, grouping, ...
- based on contemporary colloquial speech [2] and music [3]

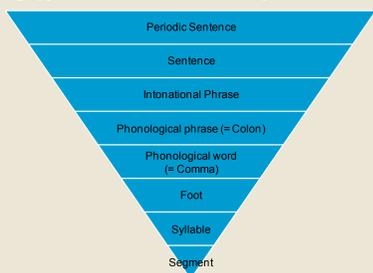
Examples:

- isocolic step-down-line (W.C.Williams) related to the imagistic rhythm of cadence [4] which is similar to the idea of parsing-by-chunks [5]
- isoperiodic rhythm (A.Ginsberg, C.Olson) based on breath units [6]

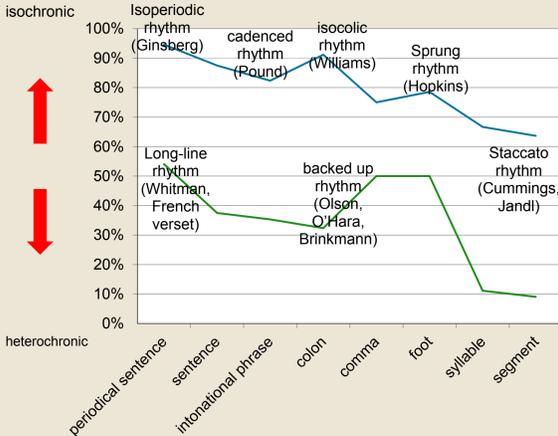
Consequences:

- considerably more complex and diverse usage of the linguistic hierarchy to carry poetic prosodic meaning.
- interplay of isochronicity ↔ heterochronicity on various levels

Working Hypothesis for a Prosodic Hierarchy for Free-verse Poetry



Categorization of Some Poet's Works According to Philological Analysis [7]

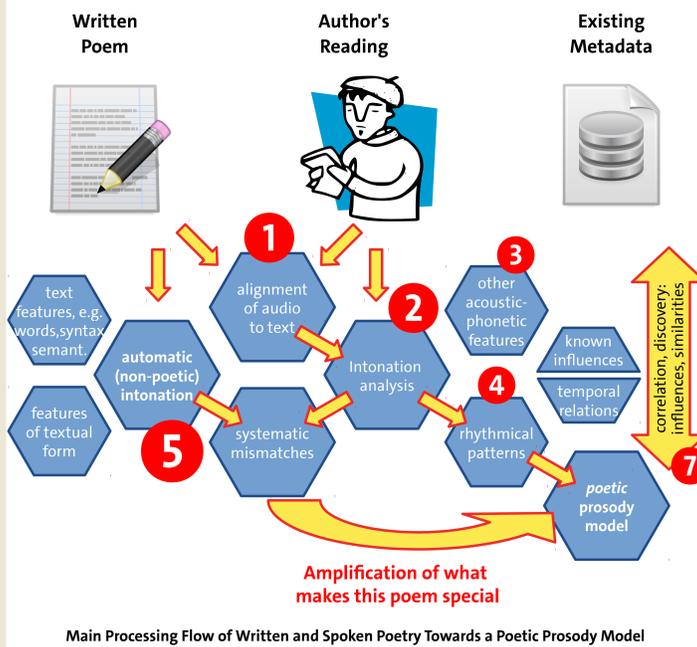


References

[1]: Pierrehumbert, J. (1980). "The Phonology and Phonetics of English Intonation". MIT.
 [2]: Gerber, N. (2015). "Intonation and the Conventions of Free Verse". In *Style* 49(1):8-34.
 [3]: Burns Cooper, G. (1998). *Mysterious Music: Rhythm and Free Verse*. SUP.
 [4]: Cushman, Steven (1985). *William Carlos Williams and the Meaning of Measure*.
 [5]: Abney, Steve (1991). "Parsing by chunks". In *Principle-based Parsing*, p. 257-278.
 [6]: Golding, Alan (1981). "Charles Olson's metrical thicket: Toward a theory of free-verse prosody". *Language and Style*, 14:64-78.
 [7]: Meyer-Sickendiek, B. (2014). "Rhythmusstörungen. Zur Prosodie des freien Verses in der postmodernen Lyrik". In *Störungen im Literatur- und Mediensystem*, p. 347-361.

Methodology

1. automatically align the author's speech to the written poem
 → also useful for manual inspection and a prerequisite for annotation
2. extract prosodic features (e.g. ToBI [1])
 → however, ToBI is not complete/ideal for poetic prosody (see left side)
3. in the future: also extract other prosodic features and features of language and textual form
4. derive rhythmical patterns ("standard" prosody modeling)
 → using CRFs, HMMs, or NNs – or focus on *readable models* (e.g. RIPPER[8])
5. contrast patterns against *null model* of prosody based on speech synthesis
 → **What makes a poem special?** – whatever it is that distinguishes the poetic from from standard, non-poetic speech.
6. full project: human expert steers decision-making towards philologically relevant explanations in a *human-in-the-loop* approach:
 → introduce philologically grounded concepts (via annotation)
 → analyze preliminary models and favour 'reasonable' explanations
7. comprehend and *discover influences* using data-driven techniques



Main Processing Flow of Written and Spoken Poetry Towards a Poetic Prosody Model

Implementation

We use tools for standard speech as the basis of our tool chain:

- automatic speech-text-alignment technology [9] based on Sphinx-4 [10]
- null model of (non-poetic) speech provided by MaryTTS [11]
- intonation analysis (at present) based on AuToBI [12]
- machine-learning using standard tools such as WEKA [13]

Data Sources/Material

We collaborate with *lyrikline.org*, a website containing hundreds of hours of author-spoken poetry. We intend to extend our collaboration to further partners (such as *PennSound* and *PoetryFoundation*).



References (cont'd)

[8]: Cohen, W. (1995). "Fast effective rule induction". In *Procs. of ICML*, p. 115-123.
 [9]: Katsamanis et al. (2011). "Sailalign: Robust long speech-text alignment." *Procs. of the Workshop on New Tools and Methods for Very-Large Scale Phonetics Research*.
 [10]: Walker et al. (2004). "Sphinx-4: A flexible open source framework for speech recognition," Technical Report, Sun Microsystems.
 [11]: Schröder, M. and Trouvain, J. (2003). "The German Text-to-speech synthesis system MARY." *International Journal of Speech Technology*, 6(3):365-377.
 [12]: Rosenberg (2010). "AutoBI – a tool for automatic ToBI annotation". *Interspeech*, p. 146-149.
 [13]: Witten, I., Frank, E. (2000). *Data Mining. Practical Machine Learning Tools and Techniques*.

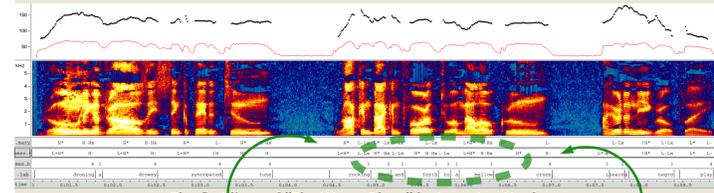
Preliminary Experiments

10 English-language poems from different modern and post-modern authors covering the full range of free verse poetry and prosodic styles.

We find that **text-speech alignment** works well:

- 90-98% coverage for half the poems
- outliers: W.C.Williams (mumbling, old recording), A. Stewart (overlaid music and echos), C. Bök (segmental sound poetry)
- problems: text normalization, grapheme-to-phoneme conversion, ...
- no formal evaluation of alignment quality (RMSE) yet

Prosodic modelling with **AuToBI** works reasonably well.



The first lines of "The Weary Blues" by Langston Hughes.

ToBI intonation of non-poetic *null model* and the author's reading:

- accumulation of differences in circled area (as observed manually by first author – a theory-agnostic speech scientist)
- result of syncopation (as explained by second author – the philological expert on the team)
- will be further examined by annotating (and machine-learning) syncopations as a phenomenon of (some) poetry
- **combination of large coverage and deep philological understanding**

Next Steps of Our Work

- scale up from 10 poems to large amounts (hundreds of hours)
- import of *lyrikline.org* corpus including representation of metadata
- reasonable use of machine learning over multitude of features
- build (web-based) infrastructure for iterative, human-in-the-loop cycling between machine learning and manual annotation
- *human effort focused on what appears interesting to the model*



Please e-mail us for further information:

- baumann@informatik.uni-hamburg.de
- bumesi@zedat.fu-berlin.de

<http://www.rhythmicalizer.net>



We gratefully acknowledge travel funding by Daimler-Benz Foundation.

Our upcoming project will be funded by a Volkswagen Foundation grant within the *Mixed Methods in the Humanities* program.

Daimler und Benz Stiftung

VolkswagenStiftung