

Implications of multifractal theory for fictional narratives

A dynamic perspective on sentiment-based story arcs exemplified by
Ishiguro's *Never Let Me Go*

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1 INTRODUCTION

- problem
- dynamic properties
- data and task

2 METHODS

- story arcs
- adaptive filtering
- fractal analysis

3 RESULTS

- global behavior
- local behavior

4 DISCUSSION

- summary

INTRODUCTION

- problem
- dynamic properties
- data and task

METHODS

- story arcs
- adaptive filtering
- fractal analysis

RESULTS

- global behavior
- local behavior

DISCUSSION

- summary



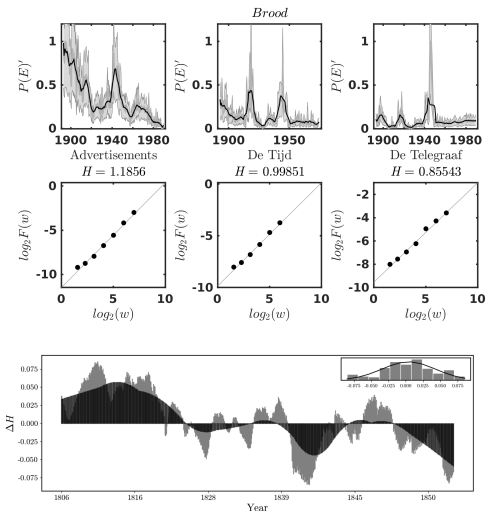
hemingway's affective theory of narrative

The moods, feelings and attitudes represented in a novel will resonate in the reader by activating similar sentiments.

⇒ extract and quantify the narrative structure that is responsible for eliciting **affective reader response**

- computational narratology with affective computing has already ‘solved’ this issue with **story arcs**
- BUT, they tend to **ignore fundamental dynamics properties** of story arcs (the evolution of)
- in the context of DH, we (indirectly) propose to **automate close reading** of fiction

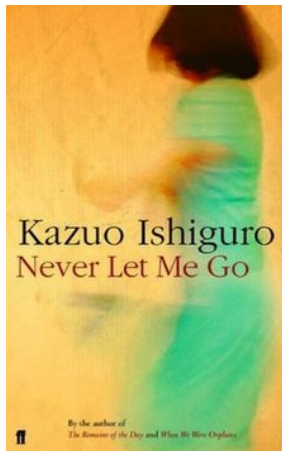
dynamic properties of cultural systems



Wevers, M., Gao, J., & Nielbo, K.L. (2020). Tracking the Consumption Junction: Temporal Dependencies between Articles and Advertisements in Dutch Newspapers, DHQ.

Nielbo, K.L., Baunvig, K.F., Liu, B. & Gao, J. (2018). A Curious Case of Entropic Decay: Persistent Complexity in Textual Cultural Heritage, DSH.

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kazuo ishiguro's dystopian novel from 2005 evolves around a group of clones raised to be organ-donors. (credit: wikipedia)

extract **story arc** using the syuzhet sentiment dictionary (*not the tool*)

– apply **adaptive filtering** at multiple time scales (segments of $n + 1$ sentences)

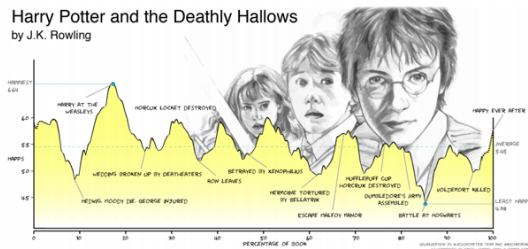
– estimate **global coherence** using the Hurst parameter

– estimate **local narrative dynamics** using time-windowed H

nb. behavior was confirmed with labMT dictionary (not the hedonometer)

sentiment-based story arcs

Harry Potter and the Deathly Hallows by J.K. Rowling



emotional arc of harry potter and the deathly hallows, by j.k. rowling. the entire seven book series display similar story arcs (credit: hedonometer / a. reagan)

- 1 'Did Crooked Hillary help disgusting (check out sex tape and past) Alicia M become a U.S.
- 2 citizen so she could use her in the debate?'
- 3
- 4 **Positive** sex, citizen
- 5 **Negative** crooked, hillary, disgusting, out
- 6 **Sentiment Score** (2+1) + (-2-1-3-1) = -4
- 7 **Sentiment Polarity** Negative
- 8 **Overall Score** Sum of all sentence scores

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data and task

METHODS

story arcs
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fractal analysis

RESULTS

global behavior
local behavior

DISCUSSION

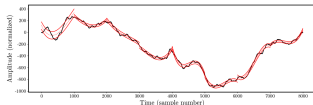
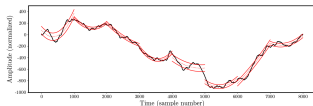
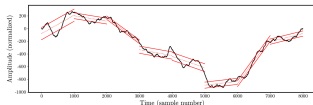
summary



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adaptive filtering



fitting of local polynomial functions for smoothing

- **partition a time series** into segments (or windows) of length $w = 2n + 1$ points, where neighboring segments overlap by $n + 1$

- **fit a best polynomial** of order D w. standard least-squares

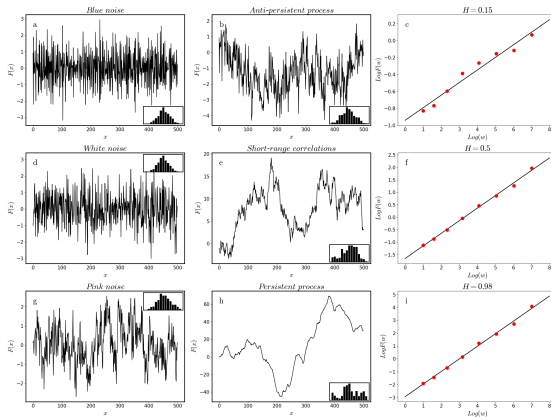
- polynomials in **overlapping regions** are combined using:

$$y^{(c)}(l_1) = w_1 y^{(i)}(l + n) + w_2 y^{(i)}(l), \\ l = 1, 2, \dots, n + 1$$

such that the **global fit** will be the best (smoothest) fit of the overall time series



fractal analysis



- **construct a random walk** $u(n) = \sum_{k=1}^n (x_k - \bar{x})$, $n = 1, 2, \dots, N$,
 - divide the random walk process into **non-overlapping segments**
 - determine the **local trends** of each segment as the best polynomial fit
 - determine the average variance over all the segments and residual $u(i) - v(i)$ of the fit is fluctuations around global trend and its variance is the **Hurst parameter** (H)
- \Rightarrow **H quantifies persistence** in time series: $0 < H < 0.5$ is an anti-persistent process, $H = 0.5$ is a short-memory process, and $0.5 < H < 1$ is a persistent process

INTRODUCTION

problem

dynamic properties

data and task

METHODS

story arcs

adaptive filtering

fractal analysis

RESULTS

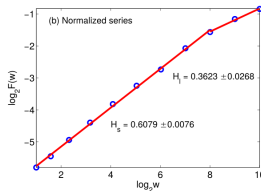
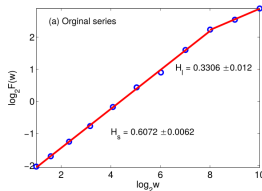
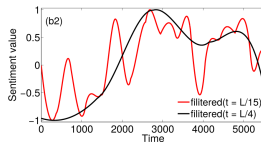
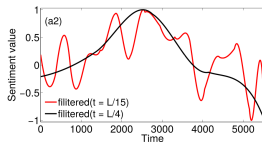
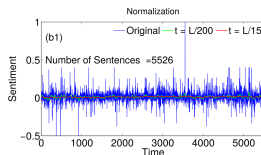
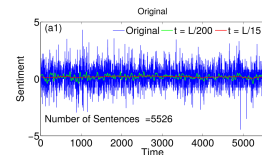
global behavior

local behavior

DISCUSSION

summary

global dynamic behavior



$0.5 < H < 1$ indicates a **coherent narrative**; $H = 0.5$ indicates a narrative that is **incoherent**, almost random (i.e., a collection of short stories); and $H < 0.5$ indicates a overly **rigid** and potentially bland narrative (i.e., a monotonous and predictable story)

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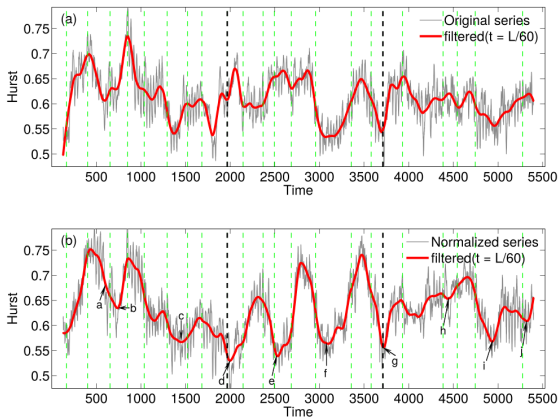
RESULTS

- global behavior**
- local behavior

DISCUSSION

- summary

local dynamic behavior



$a - j$ indicate **change points in the narrative** (suspense), e.g., temporal shift (a : present-to-past), change in cognitive or emotional states (e.g., c : Miss Lucy informs about actual state/clones)

– **local minima** reflect disruptions or points of narrative change, positive **incline** reflect continuous (persistent) narrative development, and **decline** a movement towards disruptions



- the (global) Hurst exponent of a novel's sentiment story arc provides an **index of a novel's narrative coherence**. This index can be used as an evaluation metric of how the novel's moods, feelings and attitudes will be perceived by a reader.
- as an evaluation metric, the Hurst exponent of a novel can be interpreted accordingly: $0.5 < H < 1$ indicates a coherent narrative; $H = 0.5$ indicates a narrative that is incoherent, almost random (i.e., a collection of short stories); and $H < 0.5$ indicates a overly rigid and potentially bland narrative (i.e., a monotonous and predictable story).
- the **optimal narrative** manages the reader's experience and motivation by neither being completely coherent ($H \approx 1$) nor incoherent ($H = 0.5$), but somewhere in between.
- for $H > 0.5$, the (local) **time-varying Hurst exponents reflects variation in the novel's plot**, such that local minima reflect disruptions or points of narrative change, positive incline reflect continuous (persistent) narrative development, and decline a movement towards disruptions.

THANKS

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SLIDES

knielbo.github.io/files/kln_narrative.pdf

