Taxonomy of Dance

A study in dance and data visualization

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Initial concept

I was curious...

What would choreography look like if it were treated as data and visualized without a dancer?
Could I create a visual signature for a dance that would be unique from other dances?

Would I be able to visually infer characteristics about the dance, like rhythm patterns or body symmetry?

Could I eventually use these data to perform analysis on dances?

After researching a good deal, I discovered a digital archive of choreography recorded in Labanotation maintained by the Dance Notation Bureau.

Initial concept
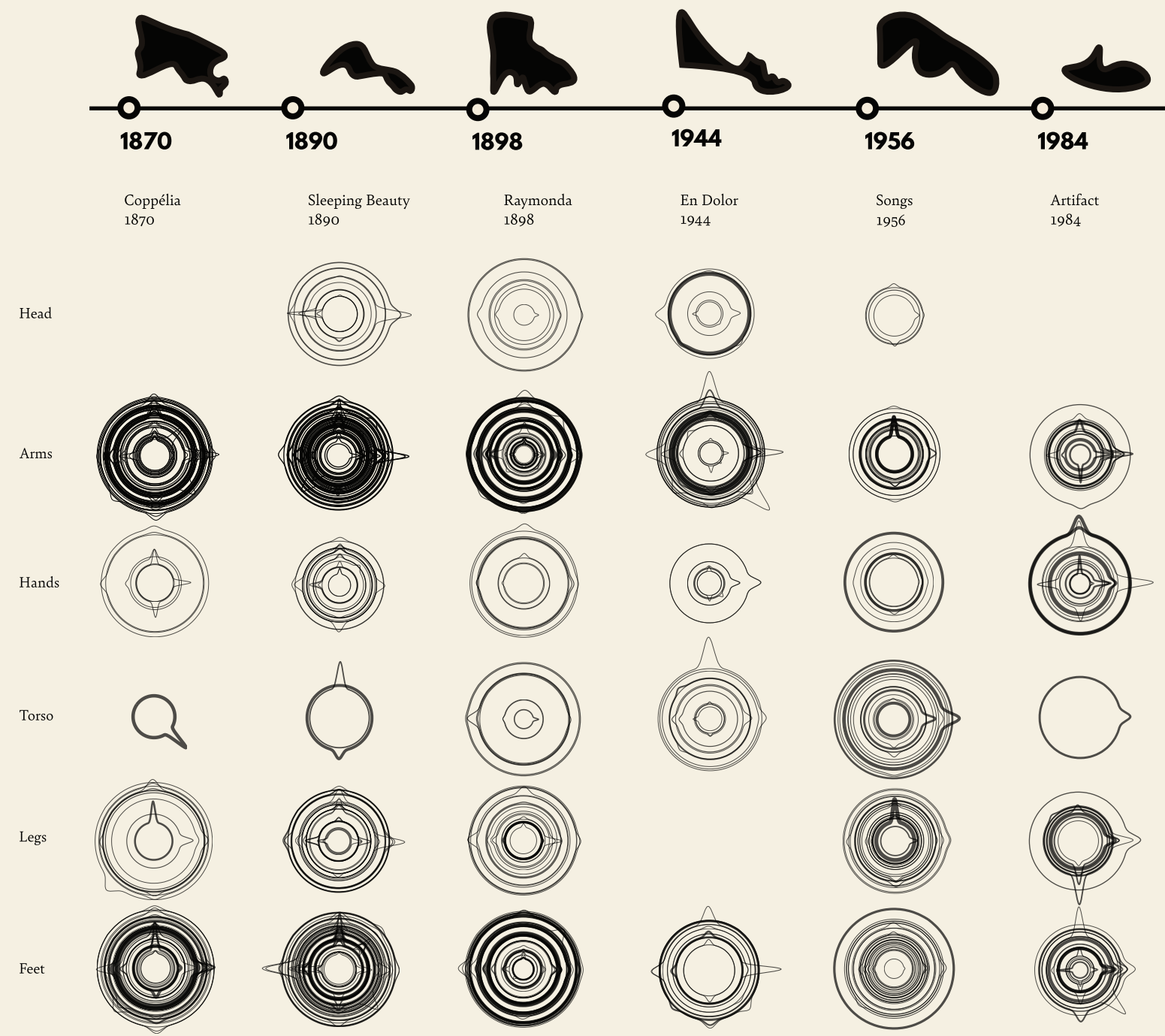
Here's a sneak peak of the final product.

Keep this visual in mind for the remaining slides.

Inspiration

Previous work:

Github repository of machine learning classifier trained to detect which culture a folktale originated from based on its text.
https://github.com/GossaLo/afr-neural-folktales

Github repository of dance notation classifier in MATLAB https://github.com/michelledebock/Labanotation
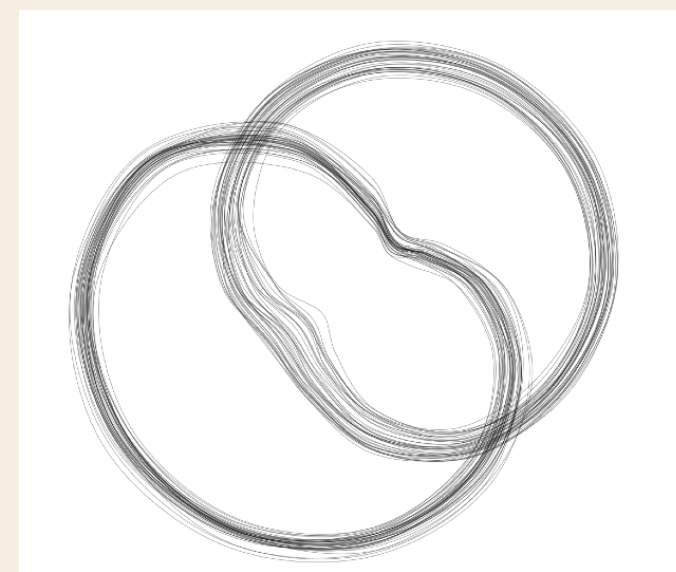
Visual inspiration:

Recording history of movement in ink

Remy Charlip's "Airmail Dances"

Intricate concentric lines

Who would be interested?

Myself- passion project

Gallery attenders interested in technology and fine art

Medium readers and people interested in analysis of qualitative data not typically shown

Dancers and choreographers who would like to experience their art form in a different perspective

Choreologists and dance notators: Dance Notation Bureau

Why?

To explore

To create delight

To inform

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Where did the data come from?

Labanotation: a form of choreography notation using symbols to denote a body movement in terms of body part, direction of movement, height of movement, and time length of movement.

The *Dance Notation Bureau* digital archive provides hundreds of pdf's and images of historical and contemporary dances recorded in Labanotation.
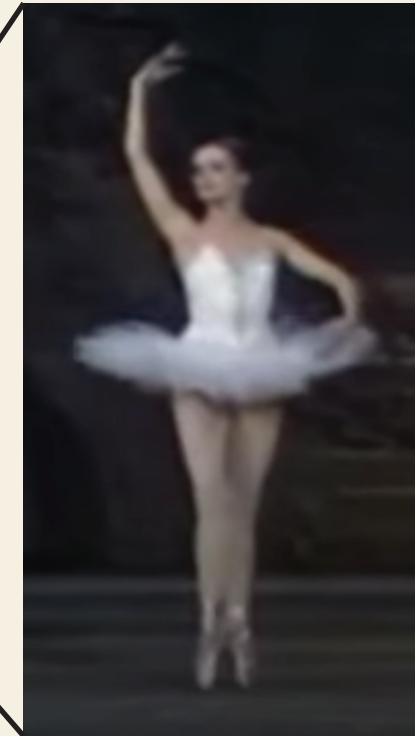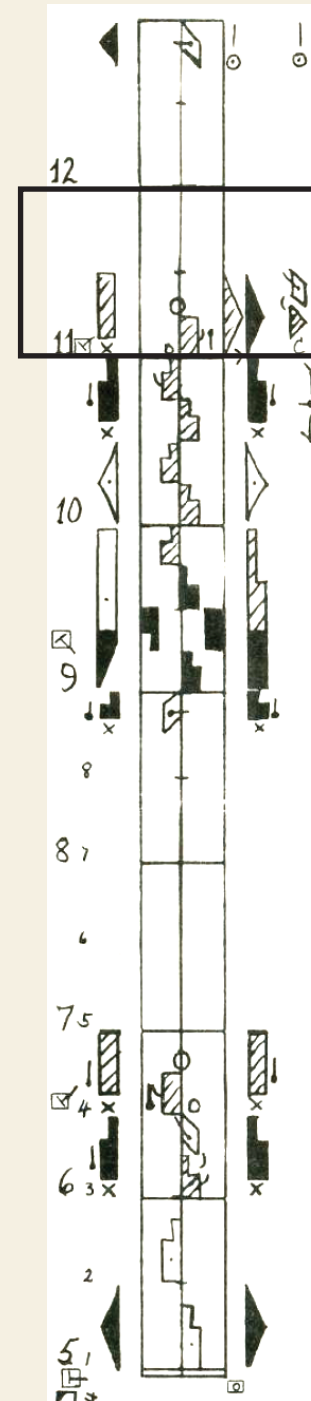
Where did the data come from?

Use labeling software to select notated movements and label with body part, direction of movement, height of movement.
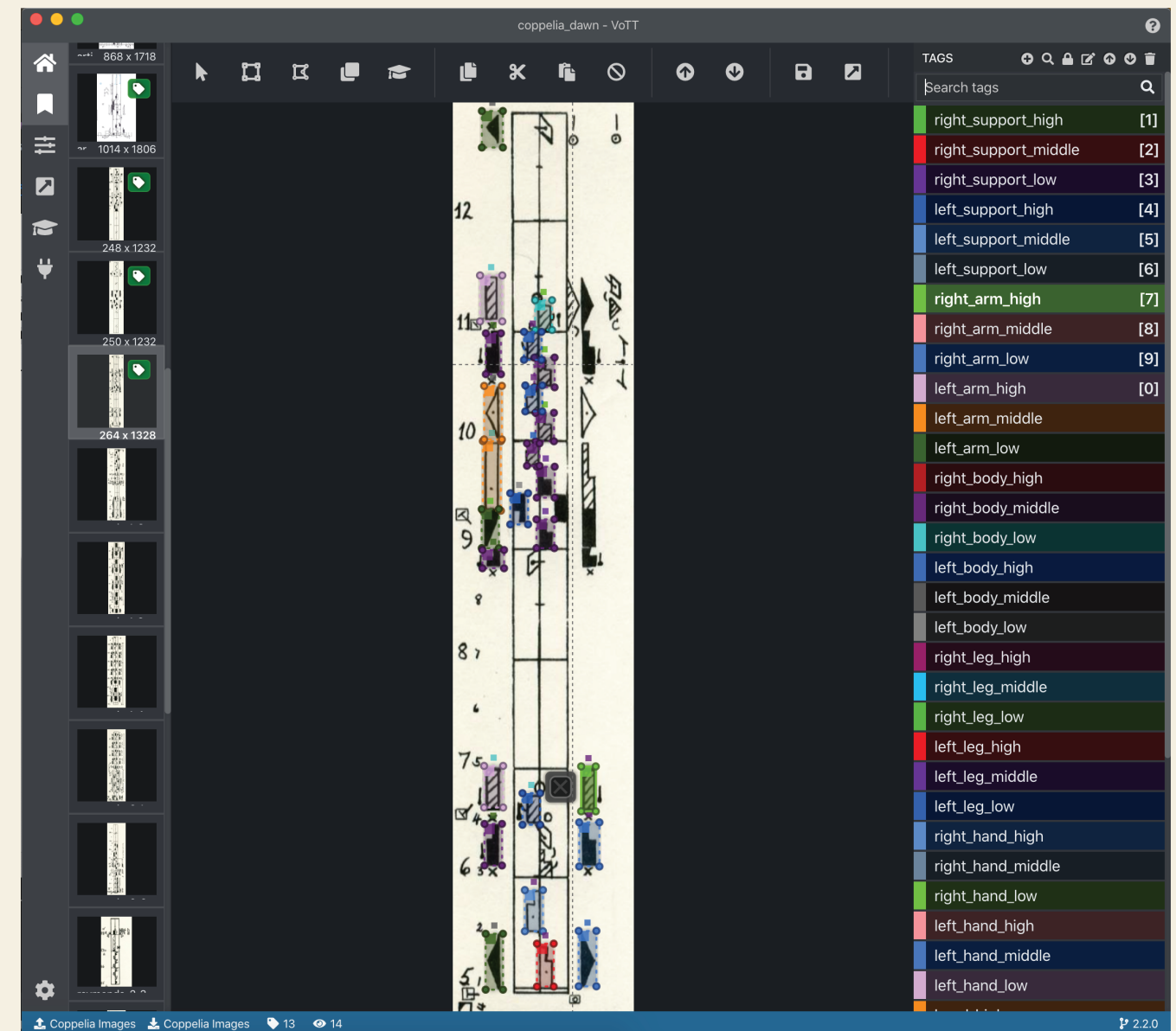
Labels for body part and movement height:
right_support_high
right_arm_low
left_body_middle
head_high
...

Labels for movement direction:
left
right
forward
forward_diagonal
place
...

Labeled dataset output fields: xmin, xmax, ymin, ymax, label1, label2.

Labeled >1500 boxes

Labeling software VoTT is a Microsoft product intended for building training datasets for machine learning classifiers.

Processing the choreography data

Wrote Python data processing scripts that parsed csv file outputs from VoTT labeling software into visualization-ready data.

The scripts parsed x,y coordinate label boxes into ordered musical measures using geometry.

Simple statistics were also performed to calculate:
1) movements per measure
2) number unique movements per measure
3) number unique movement directions per measure
4) repetition index = num unique movements / total movements in measure
5) direction diversity index = num unique directions/ total movements in measure

image	ballet	ymin	ymax	staff_num	step_length	label	direction_mc	body_moven	height_movement
coppelia_dav	coppelia_dav	1228.17559	1362.7852	1	0.37429492	left_arm_mi	left	left_arm	middle
coppelia_dav	coppelia_dav	1222.4717	1360.69901	1	0.38583206	right_arm_m	right	right_arm	middle
coppelia_dav	coppelia_dav	1232.64927	1356.01659	1	0.33844241	left_leg_low	forward	left_leg	low
coppelia_dav	coppelia_dav	1227.7108	1355.5518	1	0.3527093	right_suppor	place	right_suppor	middle
coppelia_dav	coppelia_dav	1131.84566	1216.93866	2	0.21638257	left_support_	forward	left_support	low
coppelia_dav	coppelia_dav	1093.37292	1192.95496	2	0.26258927	left_arm_lov	place	left_arm	low
coppelia_dav	coppelia_dav	1066.78771	1097.93488	2	0.04434511	right_suppor	place	right_suppor	high
coppelia_dav	coppelia_dav	976.401673	1078.91917	2	0.27195068	forward, rigł	forward	right_arm	middle
coppelia_dav	coppelia_dav	979.961784	1077.87116	2	0.25725503	left_arm_mi	forward	left_arm	middle
coppelia_dav	coppelia_dav	1035.05633	1066.0644	2	0.04390151	forward, rigł	forward	right_suppor	low
coppelia_dav	coppelia_dav	973.869224	1036.92026	2	0.14608905	forward, left	forward	left_support	low
coppelia_dav	coppelia_dav	935.834698	977.078181	2	0.07654305	forward, rigł	forward	right_suppor	high

| ballet	measure_nu	movements_	unique_body	unique_direc	repetition_in	direction_div	year	length_secor	choreograph	nationality
coppelia_dav	1	4	4	4	0	1	1870	NA	arthur_saint-	french
coppelia_dav	7	9	4	2	0.55555556	0.22222222	1870	NA	arthur_saint-	french
coppelia_dav	8	6	4	5	0.33333333	0.83333333	1870	NA	arthur_saint-	french
coppelia_dav	9	7	5	4	0.28571429	0.57142857	1870	NA	arthur_saint-	french
coppelia_dav	10	2	2	1	0	0.5	1870	NA	arthur_saint-	french
coppelia_dav	11	10	4	3	0.6	0.3	1870	NA	arthur_saint-	french
coppelia_dav	12	2	1	1	0.5	0.5	1870	NA	arthur_saint-	french
coppelia_dav	13	11	5	3	0.54545455	0.27272727	1870	NA	arthur_saint-	french
coppelia_dav	14	1	1	1	0	1	1870	NA	arthur_saint-	french
coppelia_dav	17	4	3	2	0.25	0.5	1870	NA	arthur_saint-	french
coppelia_dav	18	8	4	4	0.5	0.5	1870	NA	arthur_saint-	french
coppelia_dav	19	3	3	2	0	0.66666667	1870	NA	arthur_saint-	french
coppelia_dav	20	6	4	2	0.33333333	0.33333333	1870	NA	arthur_saint-	french

Analyzing the choreography data

Question: Can I create a feature space in which distinct clusters emerge based on when a dance was choreographed?

This could be used to eventually train a classifier which would be able to place a dance in its respective era by learning on a large dataset of Labanotated choreography.

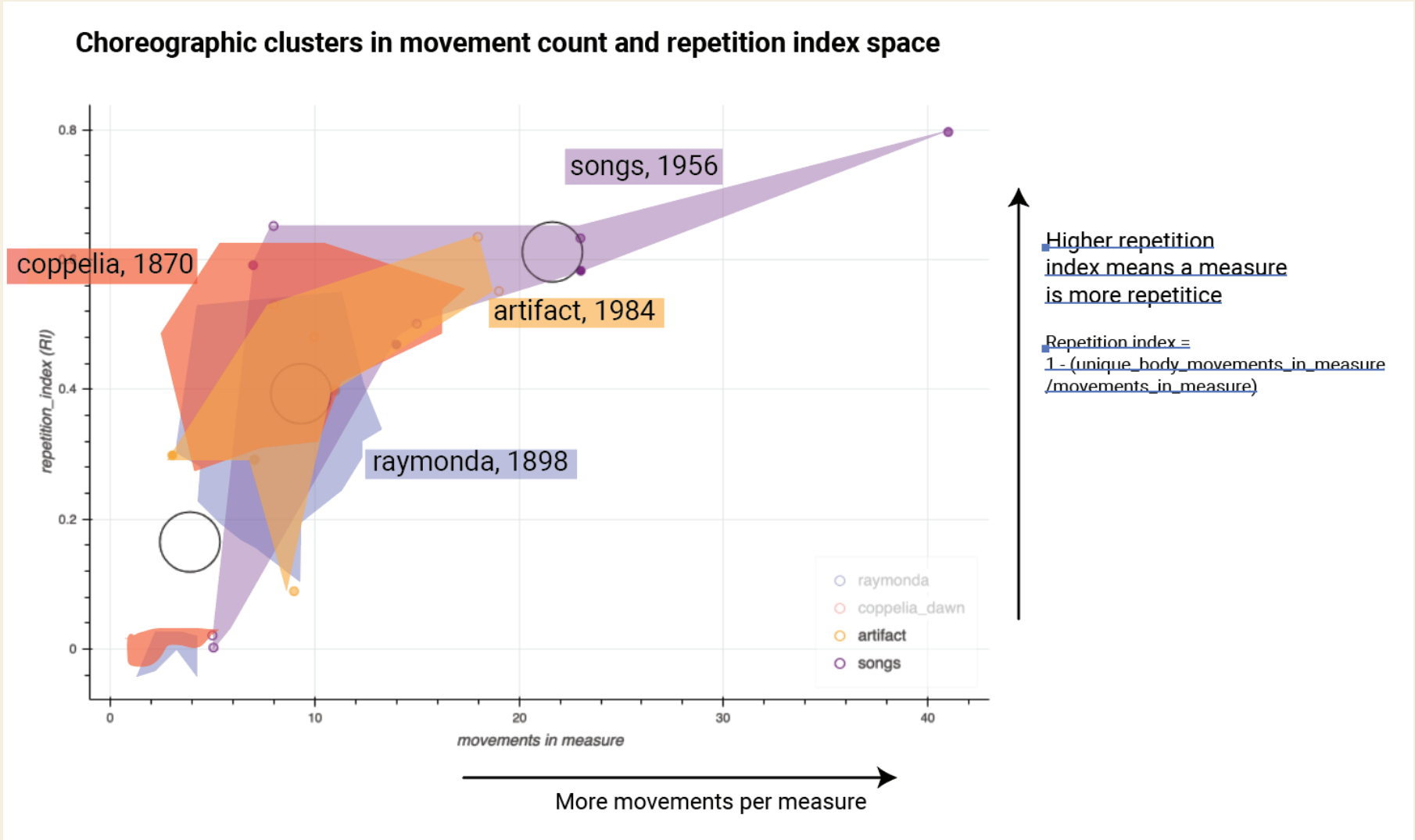Measures plotted in (repetition index, direction diversity index) space

Contemporary dance

Classical ballet

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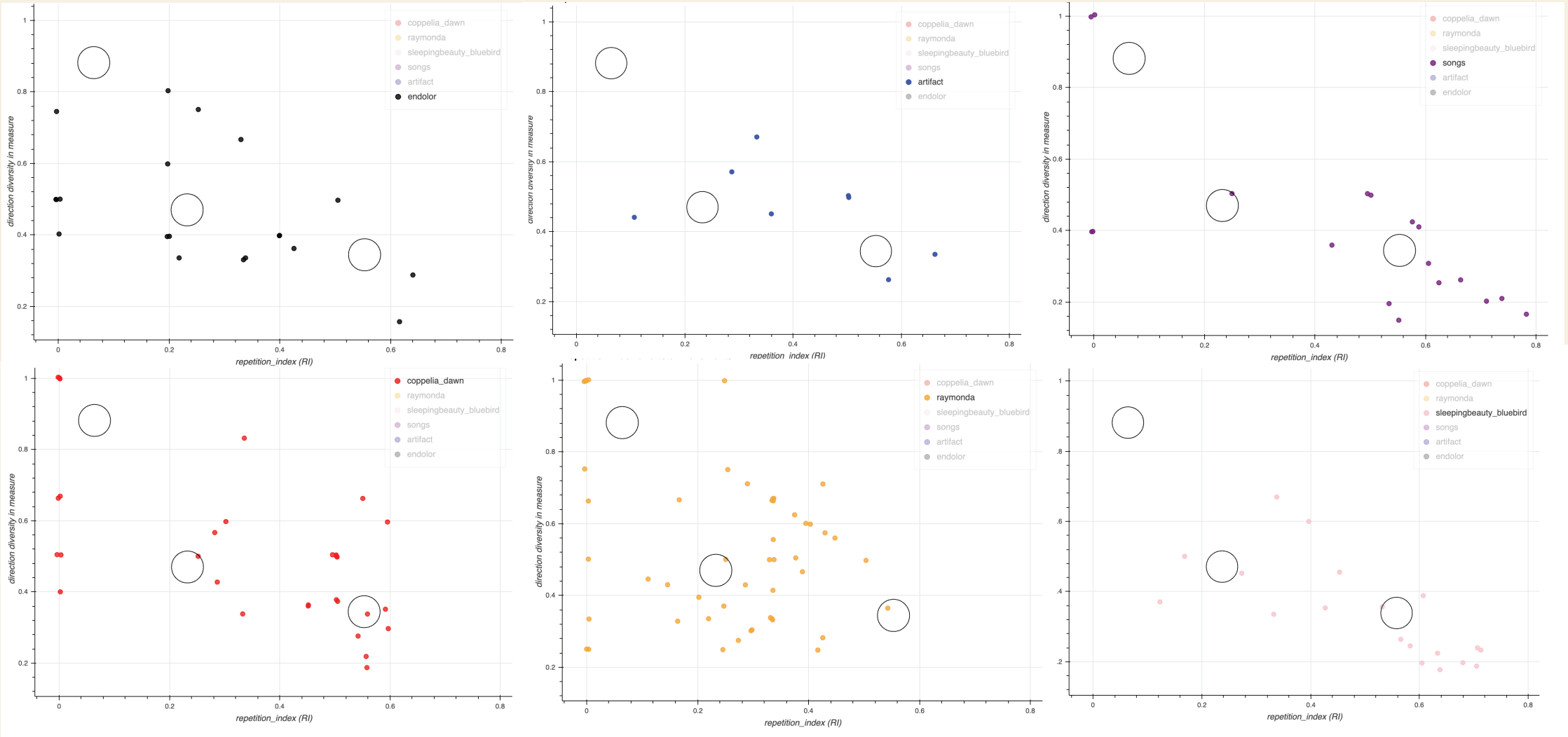
Analyzing the choreography data

Measures plotted in (movements per measure, repetition index) space

Choreographic clusters in movement count and repetition index space
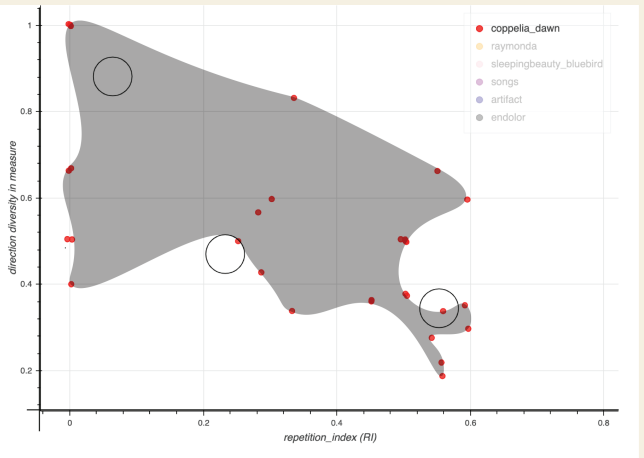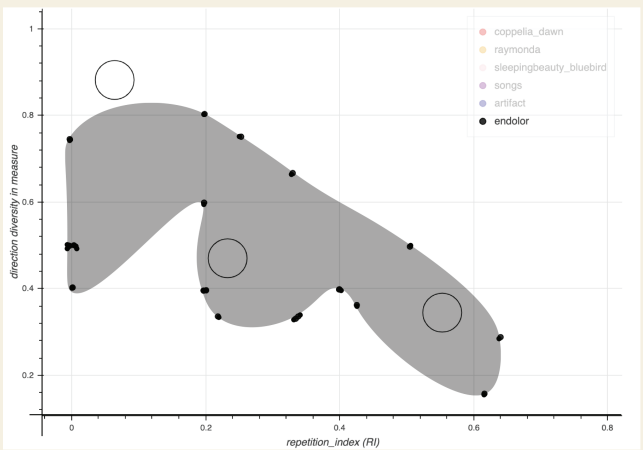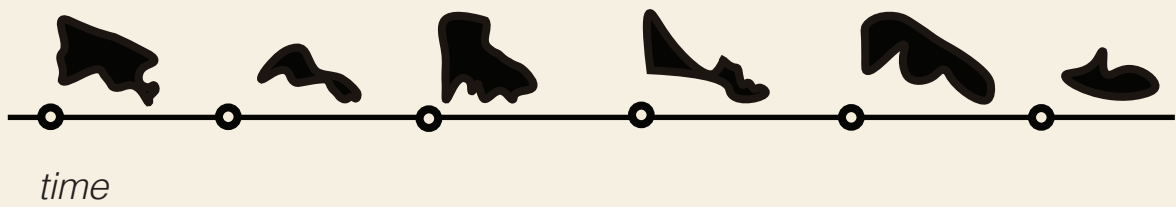
No luck with finding feature spaces where distinct clusters of measures emerge per dance...

Analyzing the choreography data

But these feature spaces still tell us something about the dances.

I can use the outline of the measure clusters to create illustrations that convey information about the repetitiveness and directionality of measures within the dance.
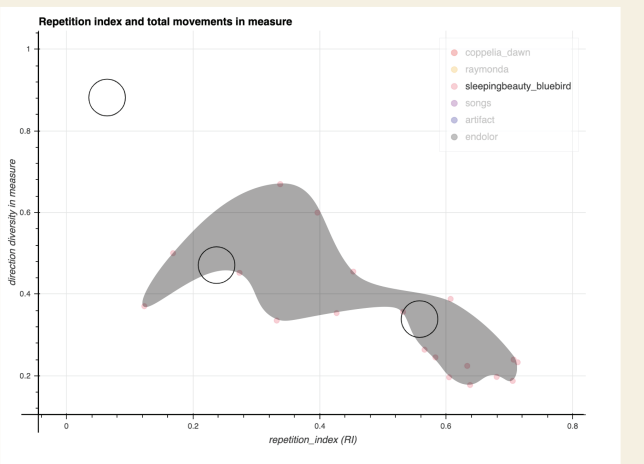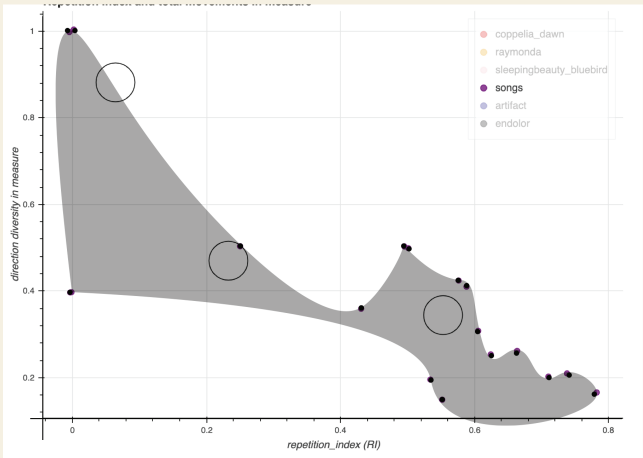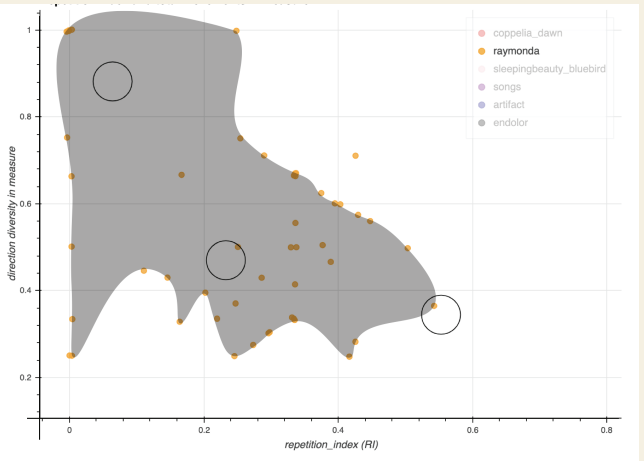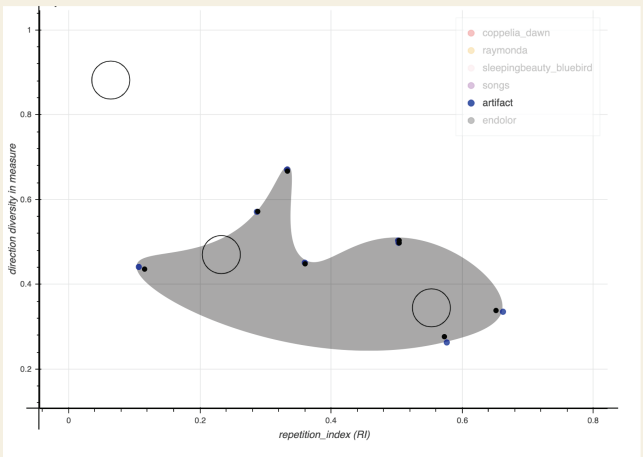
time

Initial visualizations

First step: An exploratory dashboard created with the Python library Streamlit.
Problem: I did not find much a story in the data.
Viewing the data in a timeseries plot does not make sensing rythmic patterns easy.
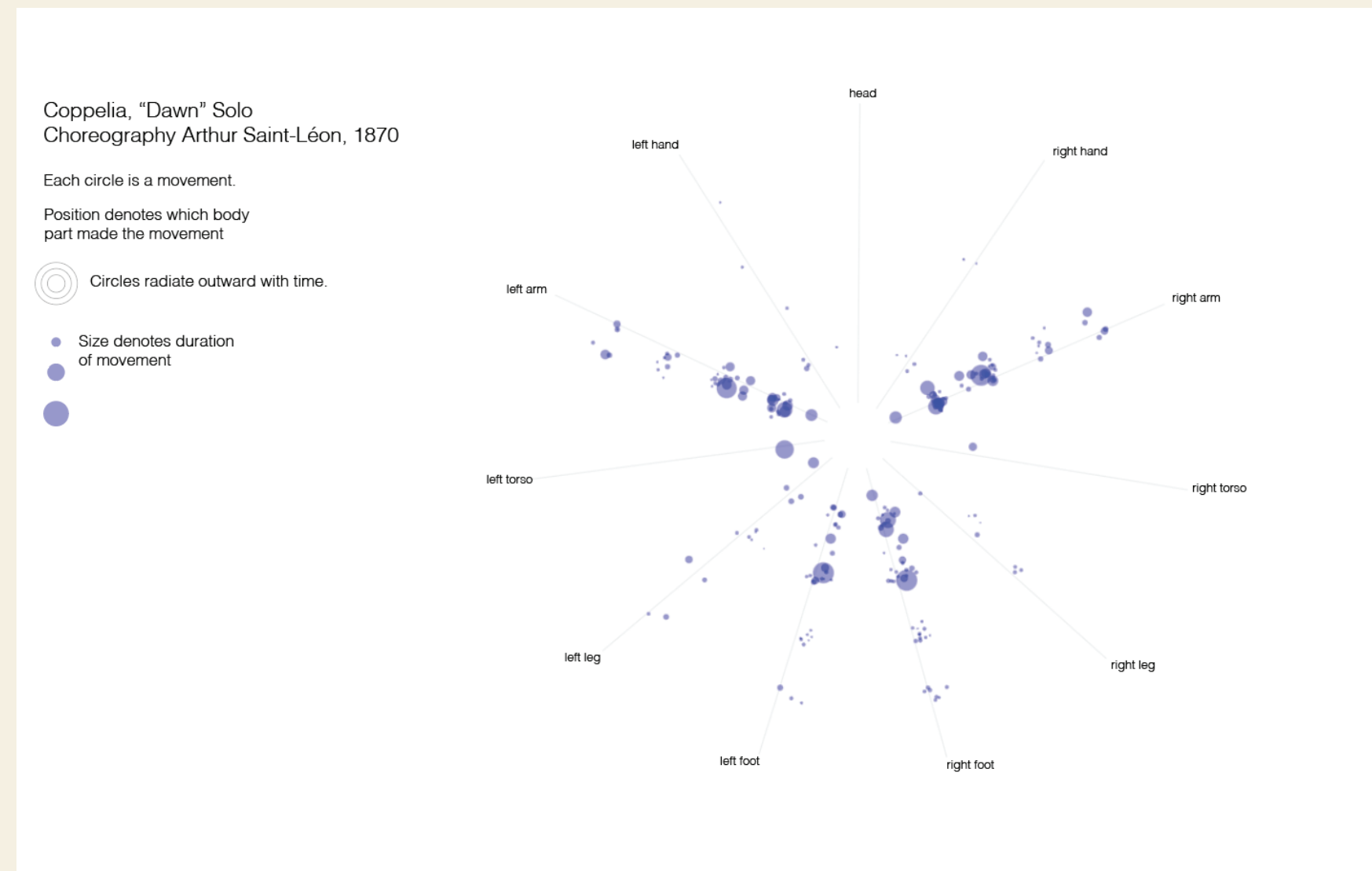Furthermore, just seeing frequency charts of movement height and direction does not give a *sense* of the dance.

Initial visualizations

Second step: What about a radial layout where movements are shown radially outward in time?
I can distribute 11 spokes radially representing all the body parts used. Hoping this psuedo-anthropomorphic design would be intuitive.
*Problem:* Although the radial form is promising, all dances are going to favor the arms and feet, therefore all dances will look similar. This does not achieve my goal of creating a visual signature for each dance.

Coppelia, "Dawn" Solo
Choreography Arthur Saint-Léon, 1870

Each circle is a movement.

Position denotes which body part made the movement

Circles radiate outward with time.

Size denotes duration of movement

Initial visualizations

Third step: Define an equation of a circle with peaks at the theta values of the body part spokes.
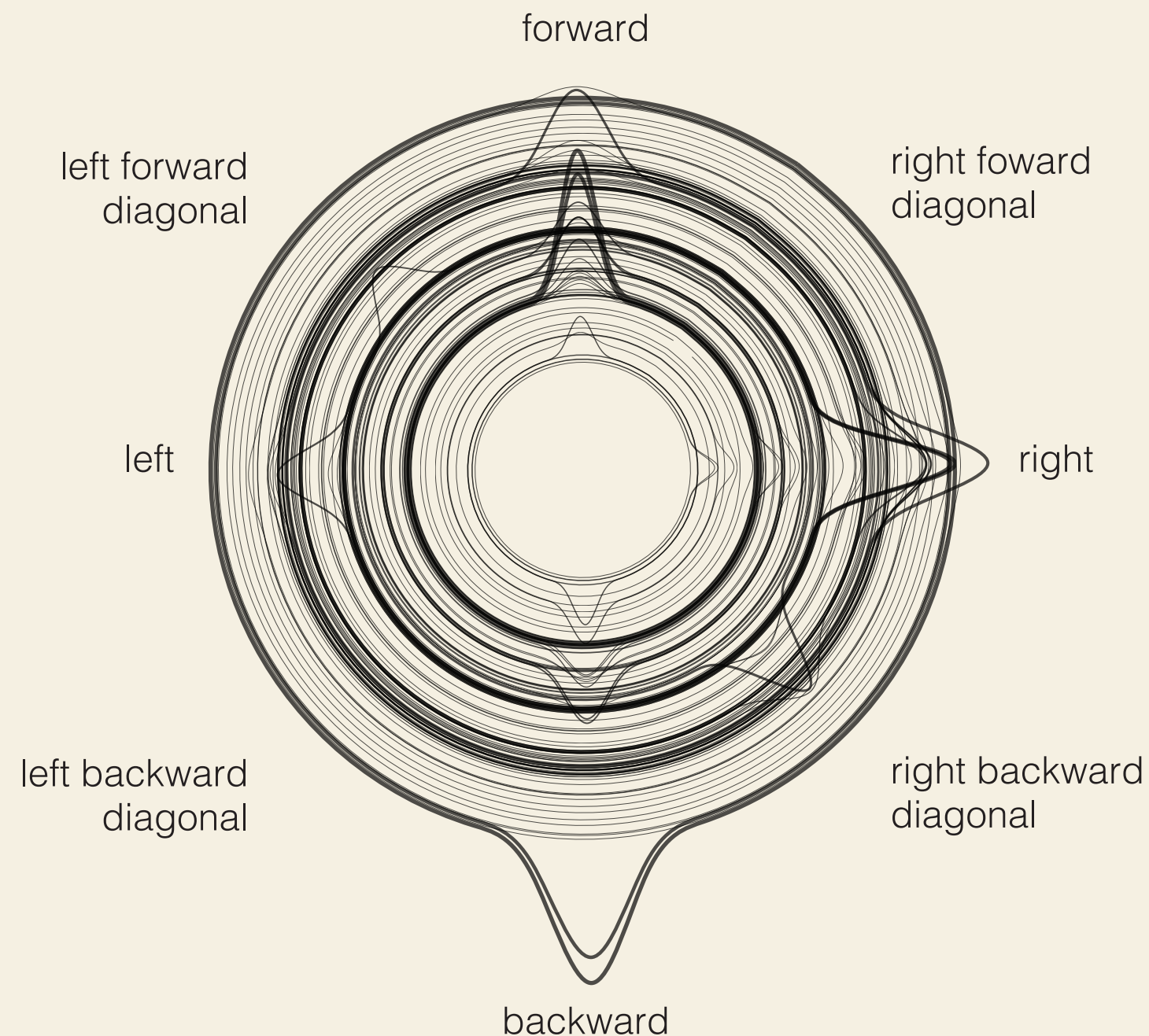*Problem:* Though this is more visually pleasing, the anthropomorphic design is not working.
Only the feet and arms stand out.
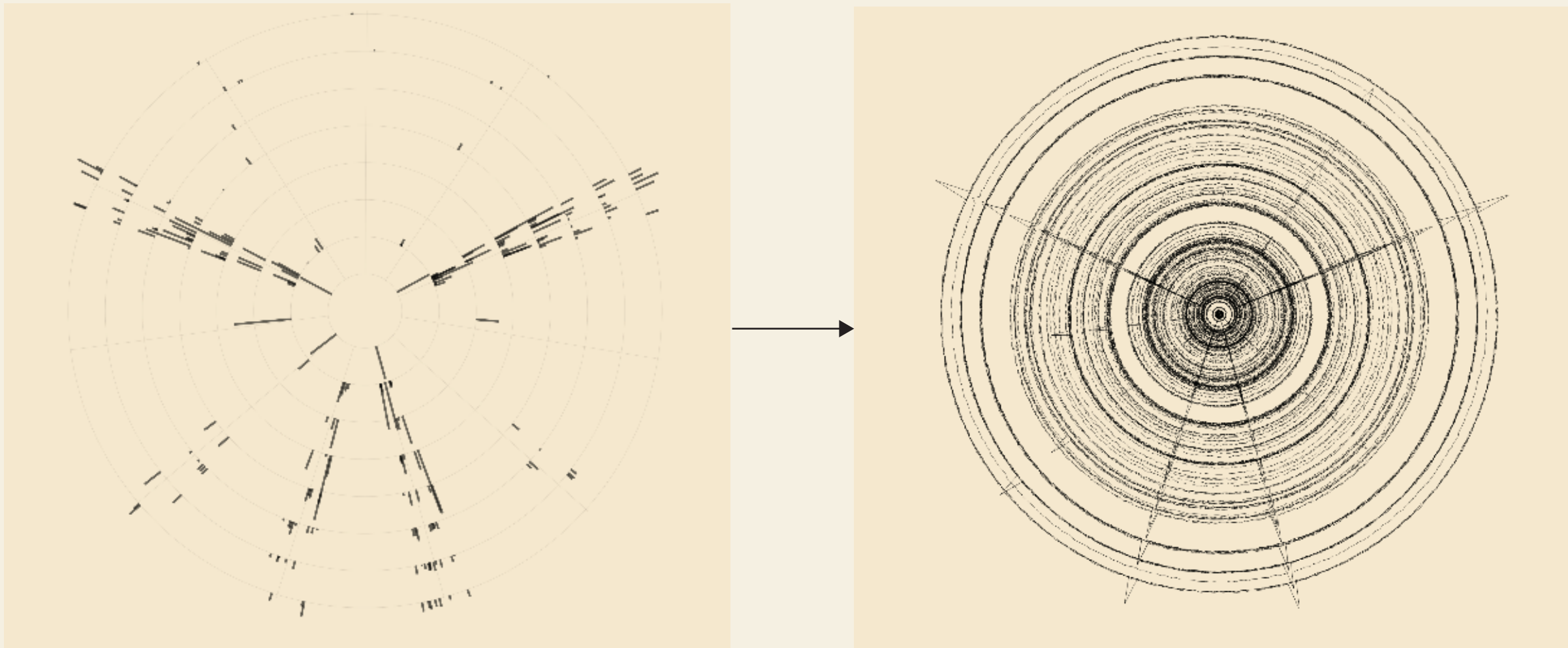
Final visualization format - Eureka!

Final step: Change the angular spokes from body part to direction of the dancer's movement.
Problem: This solves the problem of how I was going to integrate the directional information of each movement.
To show a certain body part's movements in the dance, I can simply isolate those radials from the others.

forward

left forward
diagonal

right foward
diagonal

left

right

left backward
diagonal

right backward
diagonal

backward

Benefits of the final visualization format

Conveys both directional and time data (length of spoke and thickness of radius correspond to movement length).

Temporal aspect of dance translates into visual rhythm of radii patterns.
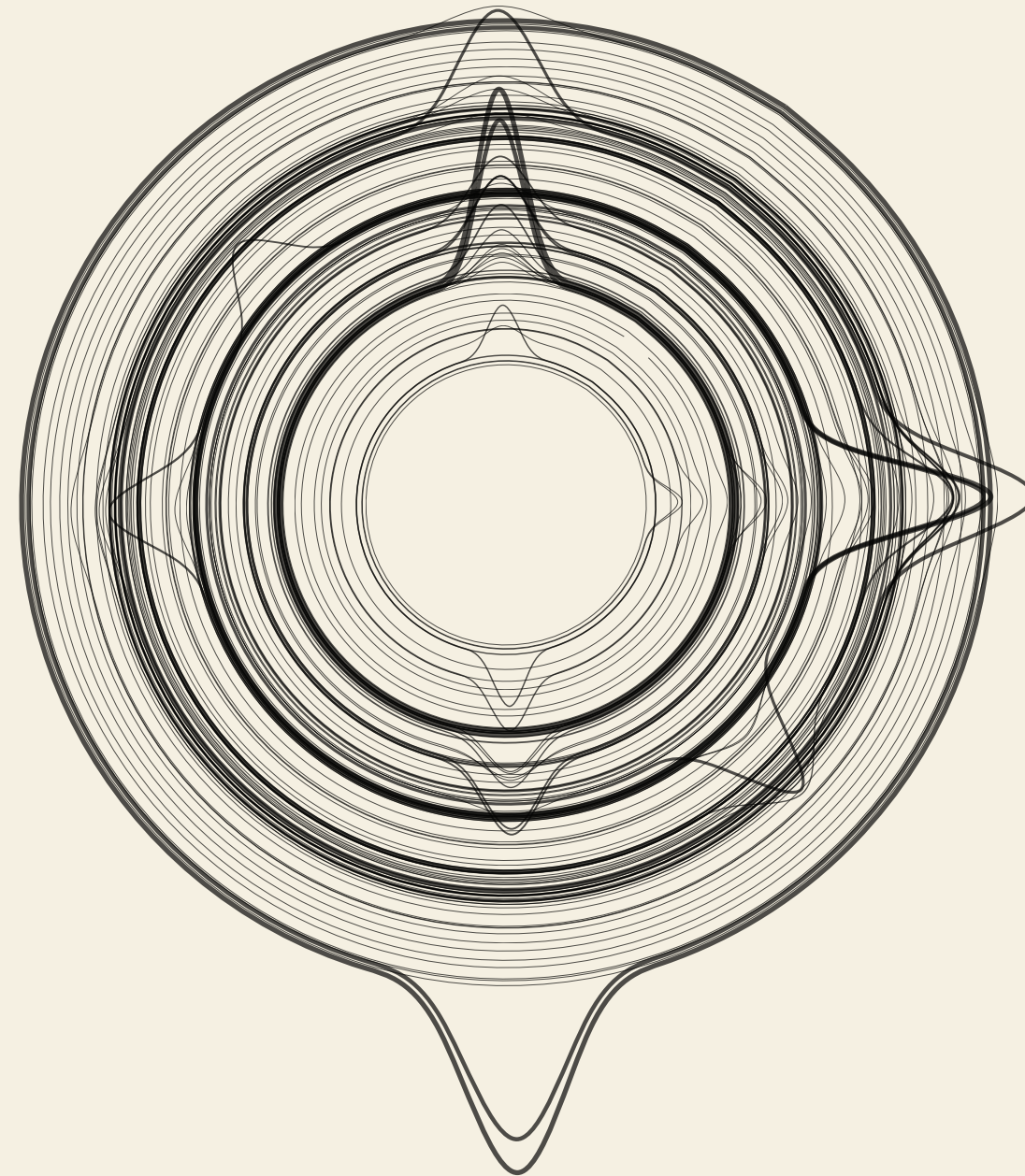
Overall corresponds to a unique signature of the dance piece by using the visual elements of:

Line width (duration of movement)
Height (duration of movement)
Angular position (direction of dancer's movement)
Radius (time)

Crafting the digital essay

Question: How should I partition these dance data so that a story emerges?
Possibilities: Time period, nationality of choreographer, or an aspect of the dance itself that emerged in analysis?

Throughout analysis, no clear trends emerged across nationality (due to historical global intermingling of choreographers).

No trends emerged from the analysis itself, probably because of my small sample size.

The most logical choice was to present the choreographic visualizations within formal partitions that already existed: historical periods of western dance.

The two that presented most visual contrast were the *Classical (1800s)* and *Contemporary (1950s onward)* periods.

What remained was to choose a sampling of dances from these periods and construct a narrative.

Crafting the digital essay

Question: What narrative flow would introduce the visuals understandably while presenting an enjoyable exporation into the era partition and each dance itself? How best to convey the impression of a dance?

1. Reading graphic guide to visualizations (priming)
2. Table of contents graphic
3. Era introduction
4. Animated visualization playback
5. Era overview
   Repeat 3-5 for second era
6. All dances overview
7. Colophon

Thank you

https://taxonomy-of-dance.herokuapp.com/