Timber building modelling

Project Work I.

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Motivation

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The main project related paper [1] addressing this issue presents a surrogate model in place of an existing finite element model for a specific building.

My work has addressed the difficulties encountered in constructing a specific part of this model.

Problem statement

- The data we work with consists of six parameters and their associated eigenfrequencies and mode shapes, derived from measurements with a total of 10,000 records.
- The parameters describe six physical properties of the building. For each dataset there are six eigenfrequencies and six associated mode shapes (26-dimensional vectors).

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- The parameters describe six physical properties of the building. For each dataset there are six eigenfrequencies and six associated mode shapes (26-dimensional vectors).
- The problem is that due to the overlapping distribution of eigenfrequencies, it is not always correctly identified which measured mode shape actually belongs where.

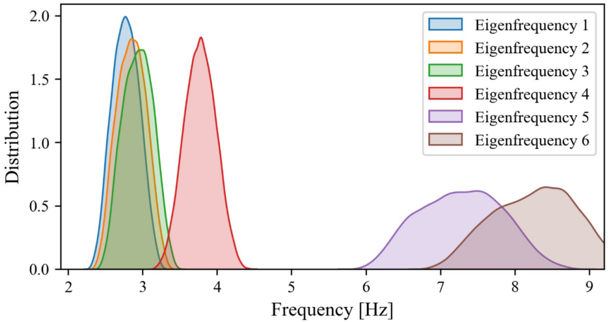

Figure: Overlapping distribution of eigenfrequencies [1].

Problem statement – visually

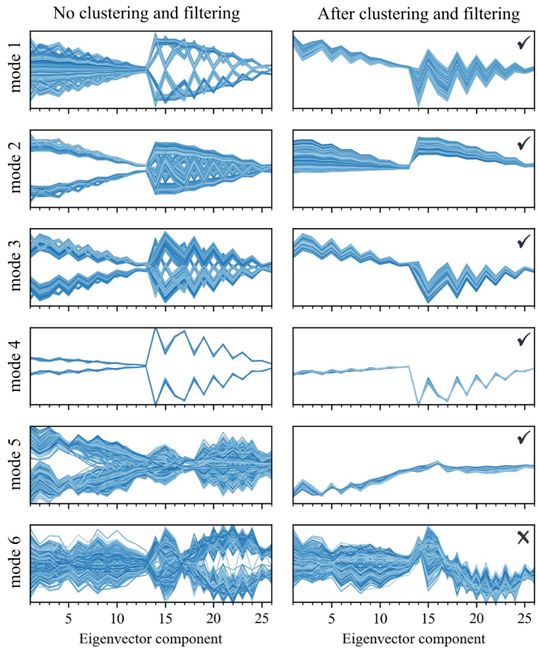

Figure: Illustration of the problem of mode shapes [1]. Our goal is to untangle them.

Results

We could easily reproduce plausibly correct clustering for the first three mode shapes.

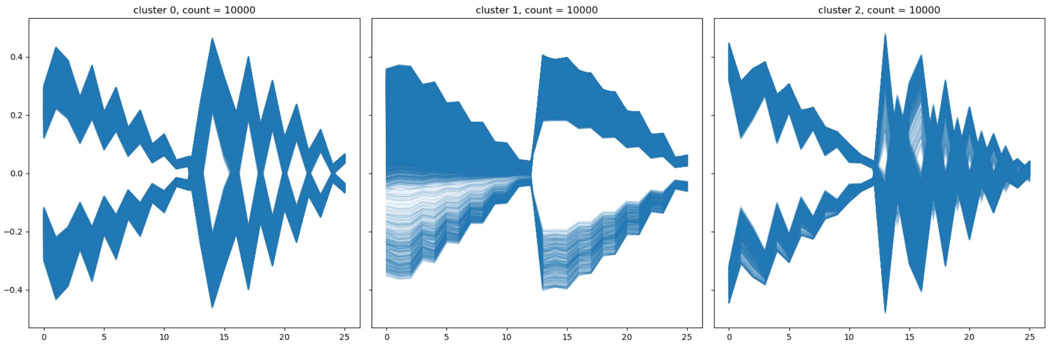

Figure: Clustering of the first three mode shapes.

Results

For the last two mode shapes, several problems were encountered.

- Unlike the first three, the mode shapes are much more varied, making the visual control less convincing.
- We cannot be sure that the measured mode shapes are indeed from these two (fifth and sixth) and not possibly belong to additional (unmeasured) mode shapes.

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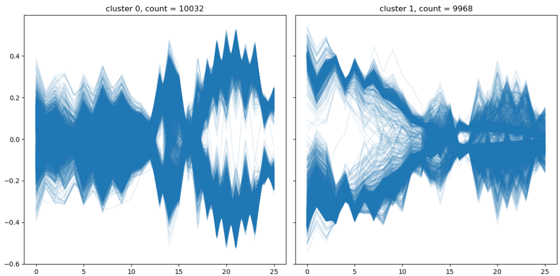

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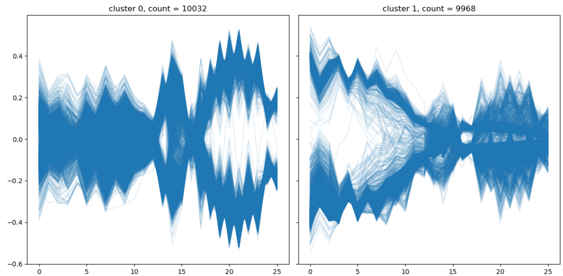

Figure: Clustering of the last two mode shapes.

We found only 30-40 incorrectly clustered records, almost as many as the deviation of the cluster sizes from 10,000.

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Bibliography

Blaž Kurent, Noemi Friedman, Wai Kei Ao, and Boštjan Brank.
Bayesian updating of tall timber building model using modal data.
Engineering Structures, 266:114570, 2022.

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Thank you for your attention!