

A Quantitative Study of Violin Geometry Using Contour Lines



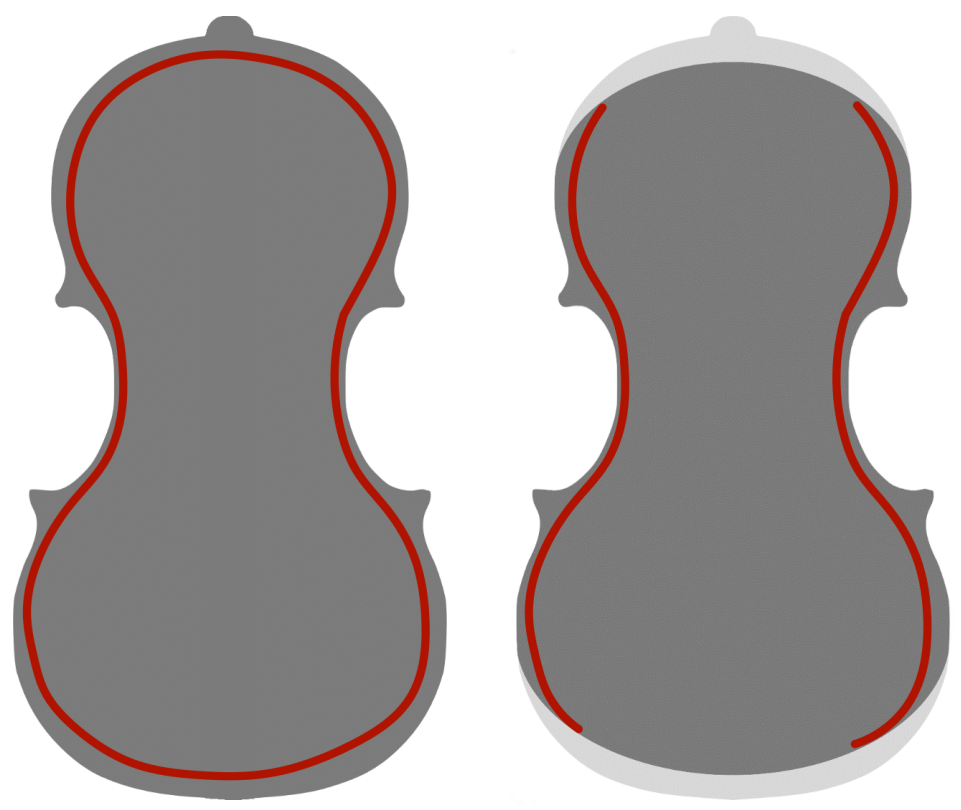
Philémon Beghin, Anne-Emmanuelle Ceulemans, François Glineur

ICTEAM, UCLouvain, Belgium



philemon.beghin@uclouvain.be

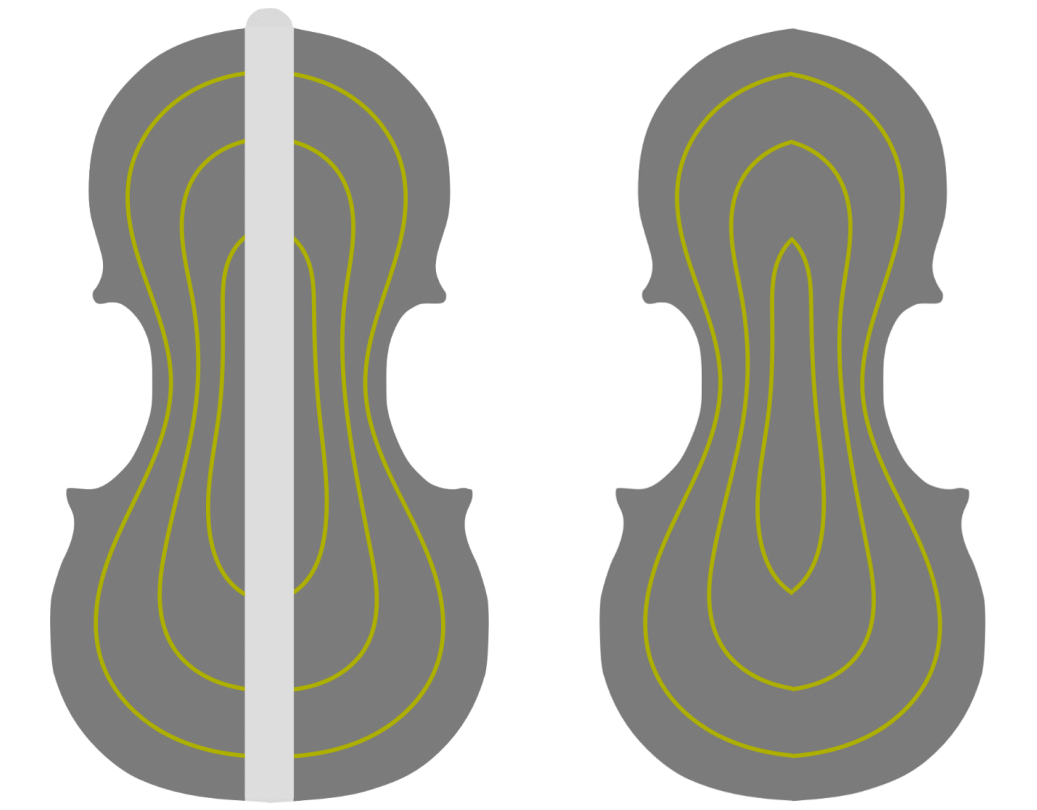
Reduction of the length [1]



Context

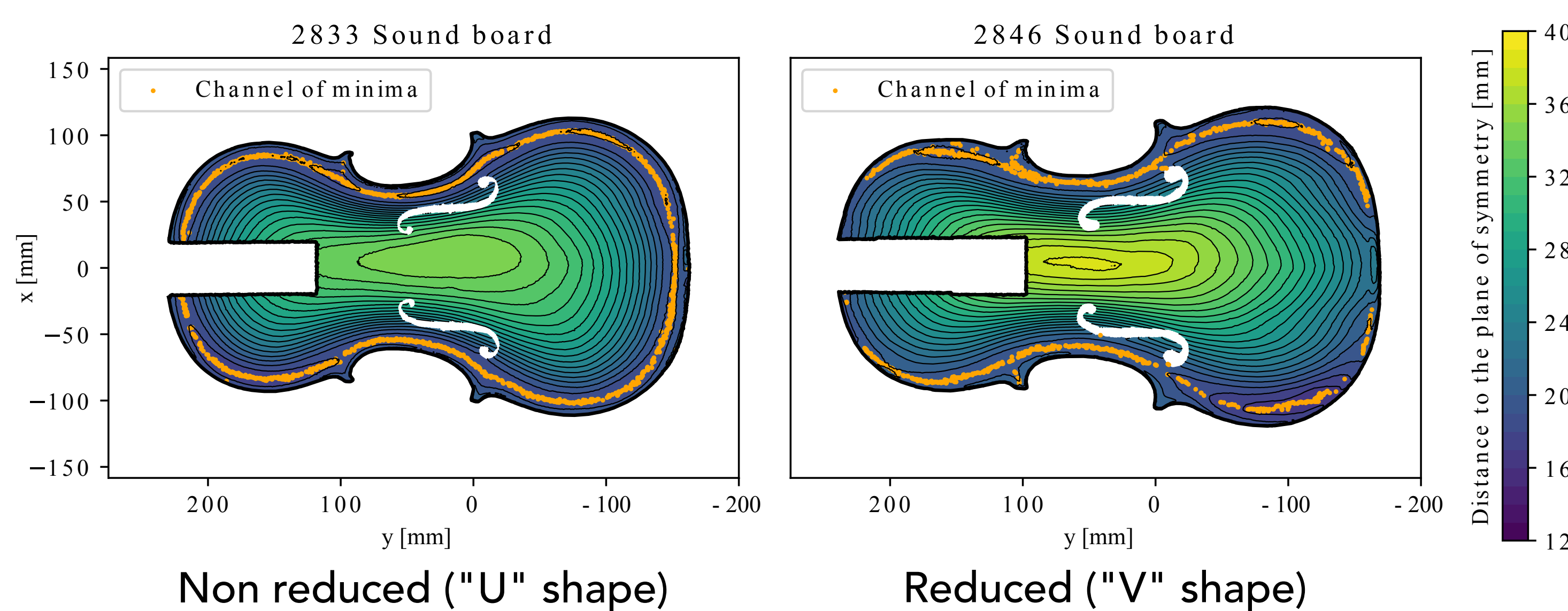
First violins in the late 16th century
After 1750: shape and dimension standards imposed
Instruments reduced to meet the standards
Few written testimonies: instruments are the best witnesses
Problem: how to quantify violin geometry?
Need for an **objective** way to tackle the 'dimensioning' problem

Reduction of the width [1]



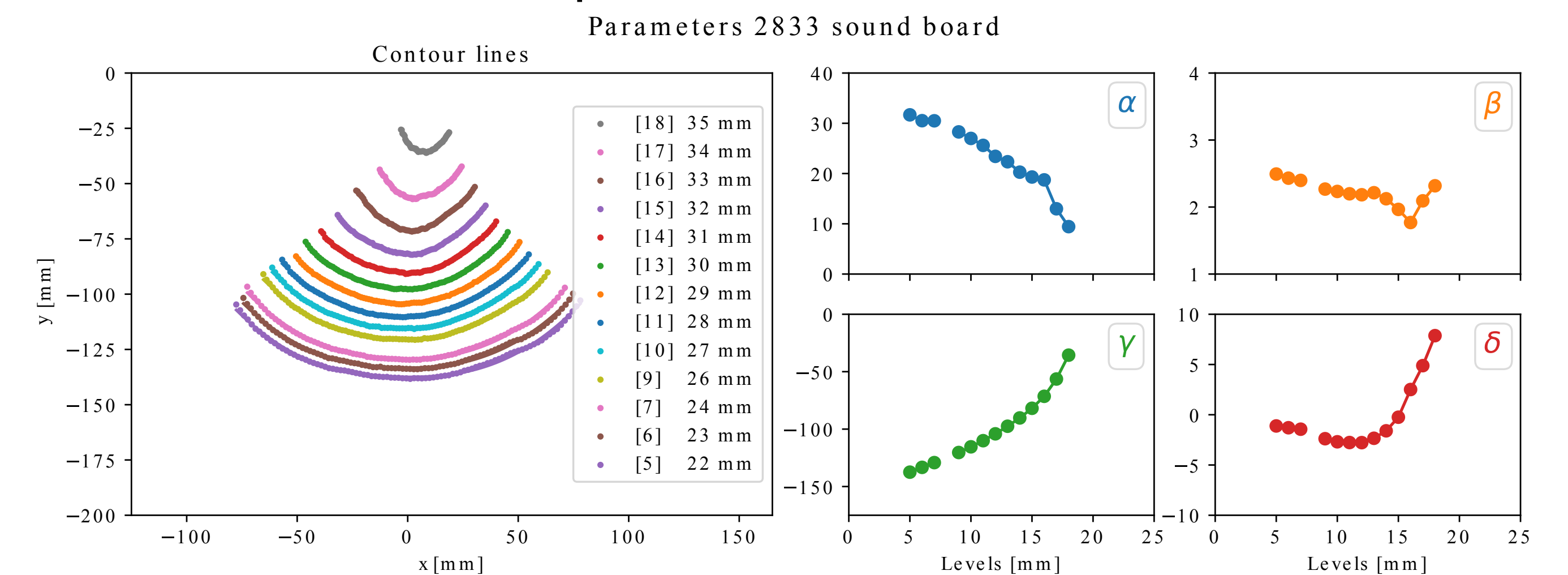
Motivation

Differentiate between (non) reduced instruments
Estimate original shape and dimensions from current geometry
Shape of contour lines is a good indicator [1,2]

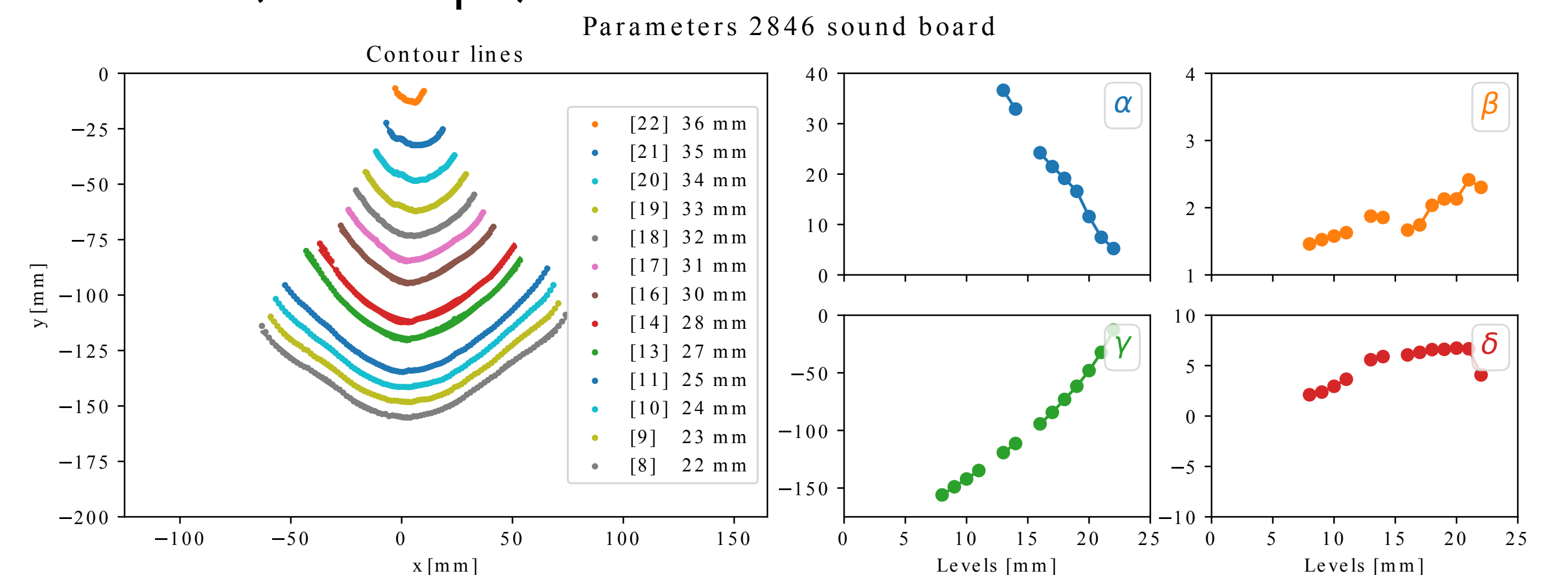


Contour Parameters

Non reduced ("U" shape)

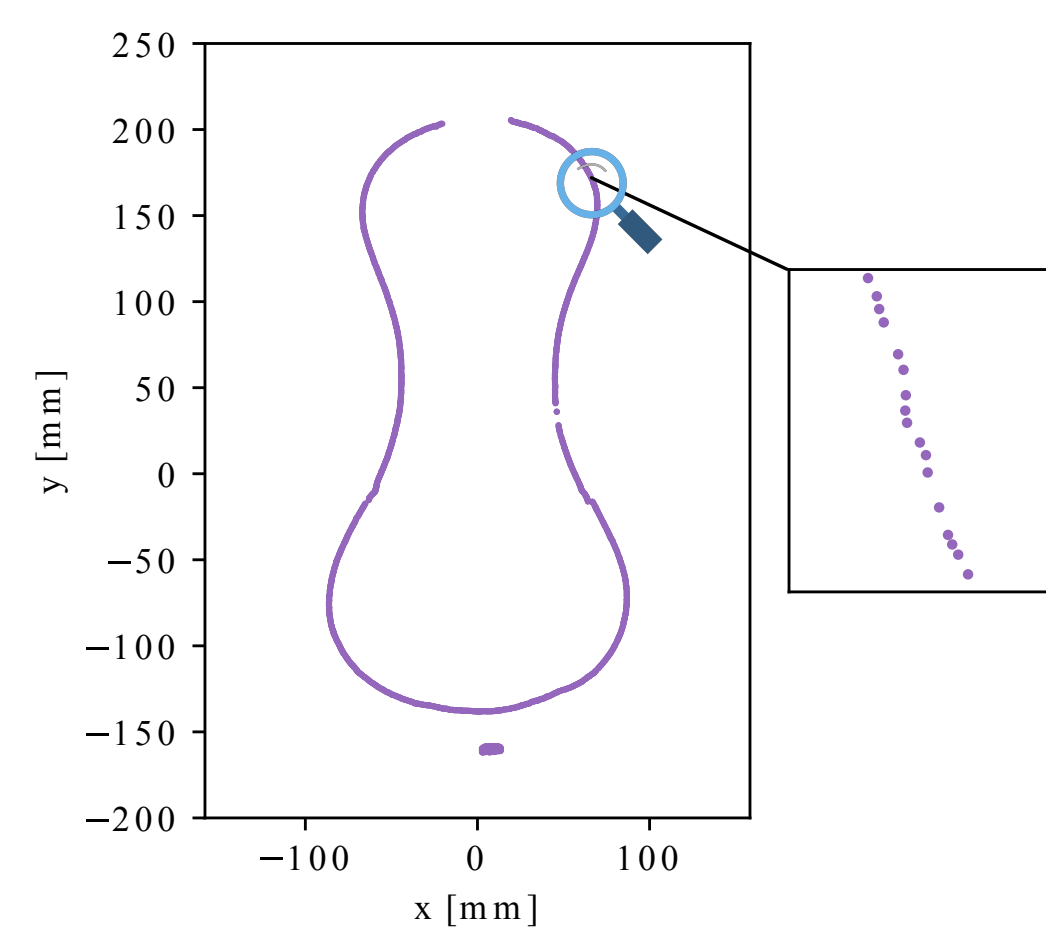
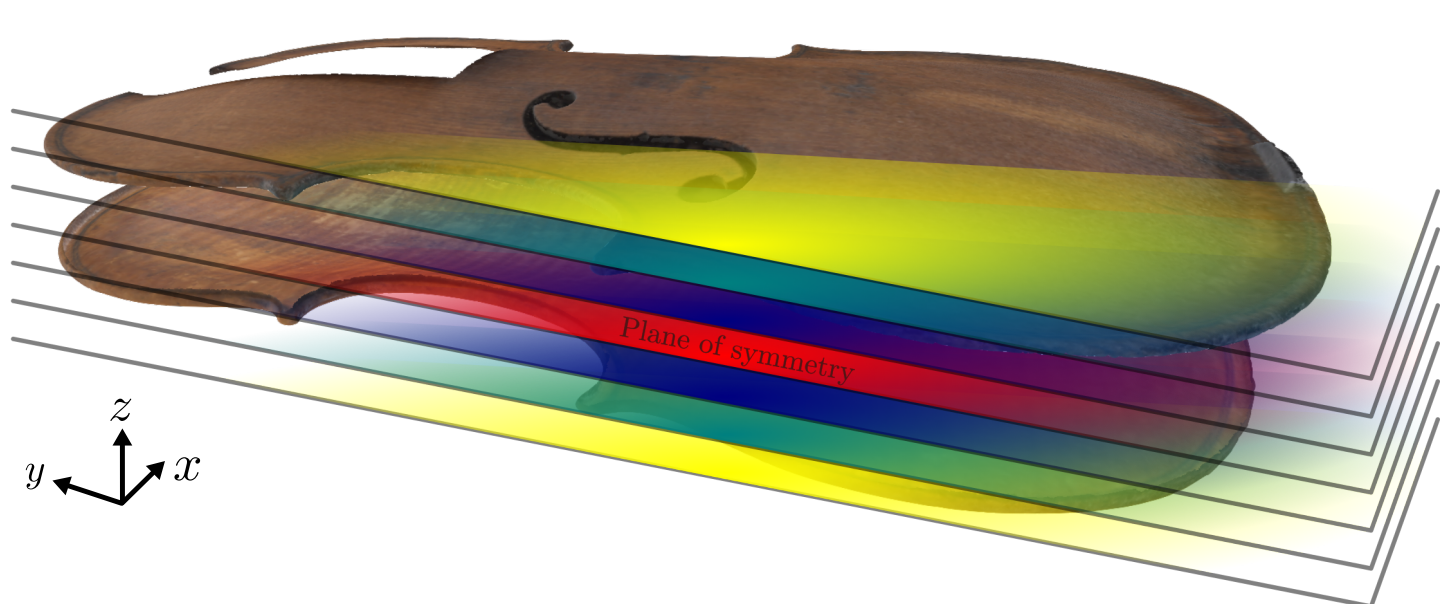


Reduced ("V" shape)



Contour Lines Fitting

Based on 3D submillimetre photogrammetric meshes [1,2]



Levels computed every millimetre

Slice of a non reduced instrument at its 5th level

Parametric curve fitting

$$y = f(x) = \alpha \left| \frac{x - \delta}{\lambda/2} \right|^\beta + \gamma$$

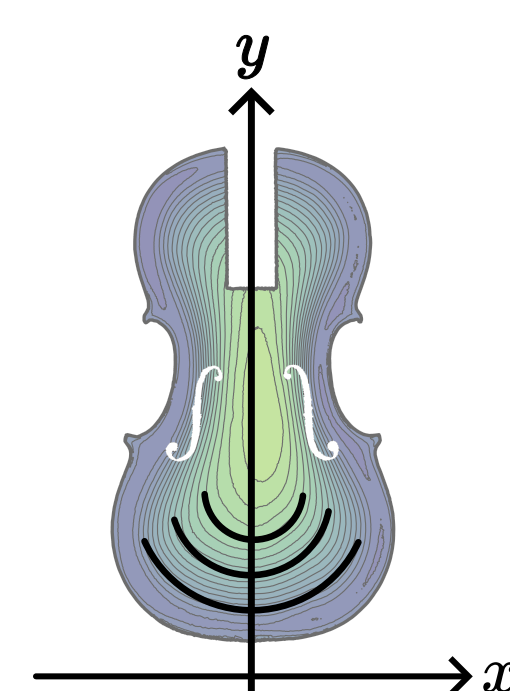
Vertical stretch/compression α

Opening of the curve β

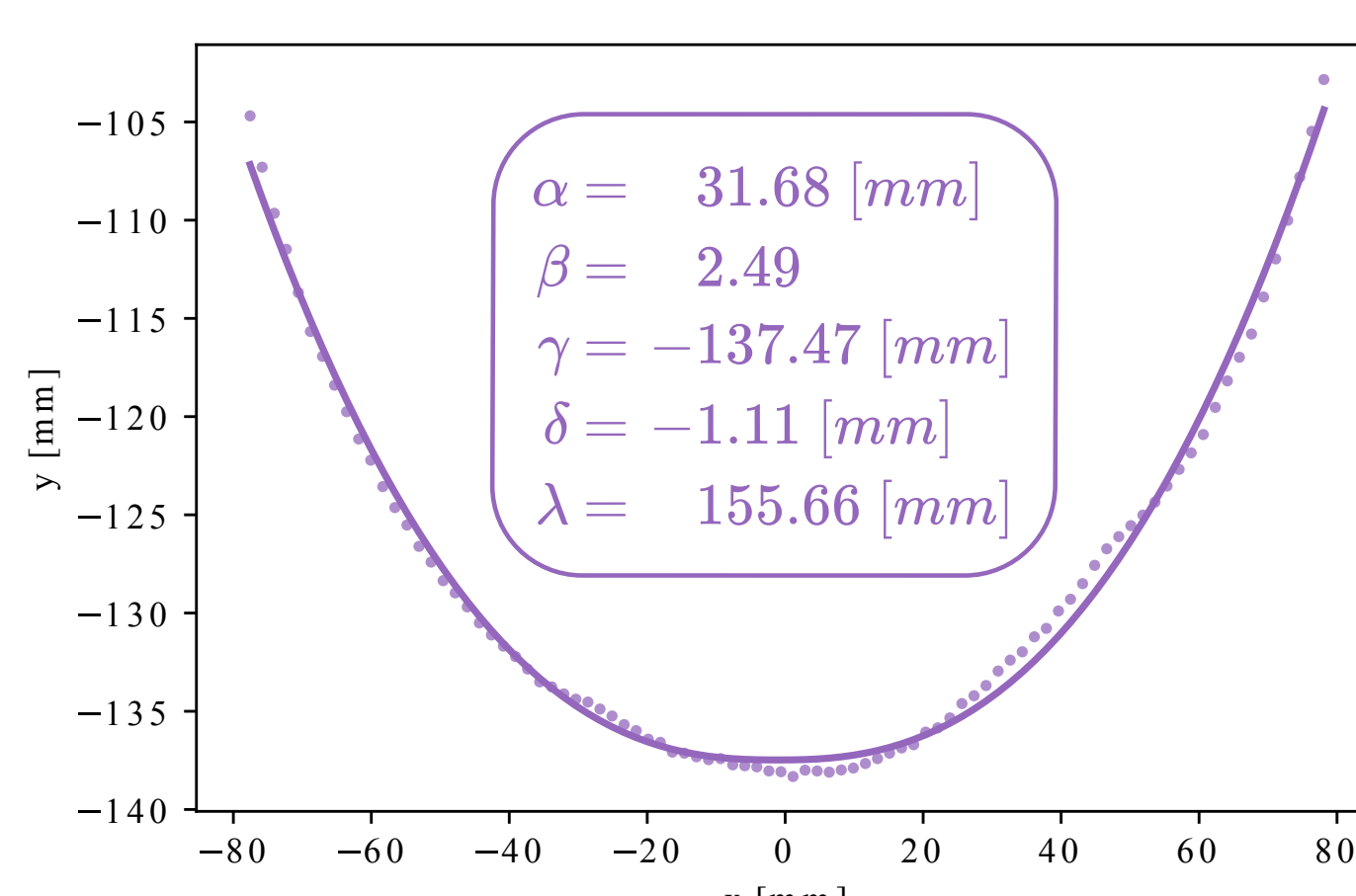
Vertical translation γ

Horizontal translation δ

With λ being the width of the curve

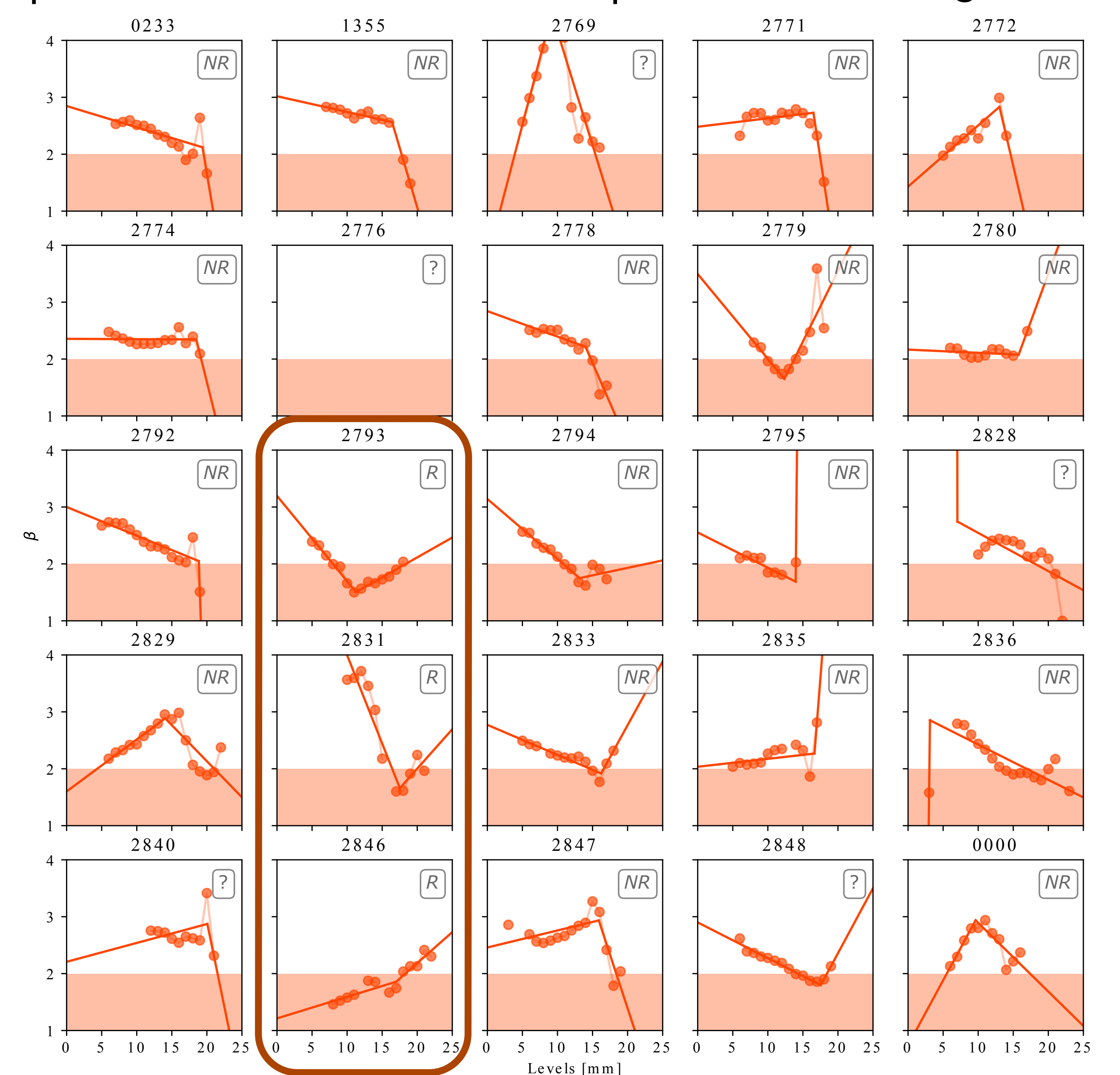


Optimal combination of the 4 parameters



Fitted curve of a non reduced instrument at its 5th level

β profile of 24 instruments and 2-piecewise linear regression



Two promising indicators:

β slopes

Presence of $\beta < 2$

Next steps

Exploitation of more features

Original dimensions estimation

Classification tool

Extended corpus

[1] Beghin Ph., Ceulemans A.-E., Glineur, F., 2024. A discussion about violin reduction: geometric analysis of contour lines and channel of minima. arXiv preprint arXiv:2404.01995.

[2] Beghin Ph., Ceulemans A.-E., Fisette P., Glineur F., 2023. Validation of a photogrammetric approach for the objective study of early bowed instruments. Heritage Science, 11(1), p.170.