



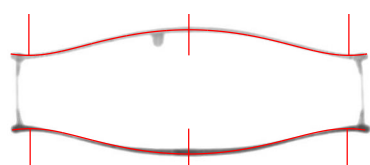
Computer Aided Violin Design

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Background: Making a Violin

- The table and back of a violin are carved from wood.
- First the shape is roughly carved by eye:
- Next the shape is carefully carved and smoothed to match a series of templates known as *cross-archings*.

- **Question:** what curves should be used for cross-archings?

In recent years, violin makers refer to books or posters that show the cross-archings of great instruments of the past.

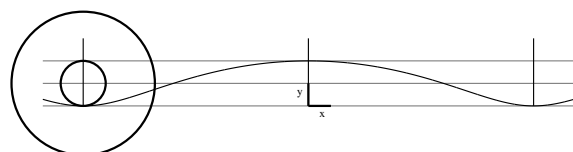
- The question remains as to where the originators of these curves obtained them.

Cycloids

- Cycloids and similar curves have a long history of use in science engineering [1].
- A curtate cycloid is obtained by rolling a circle along a line, and tracing the path of a point on the interior of the circle, a construction that was well known in the 16th and 17th centuries.
- The formula for a curtate cycloid is

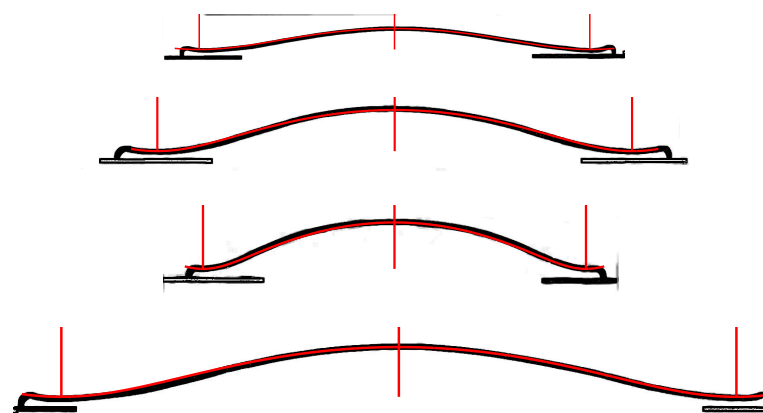
$$\begin{aligned} x &= Rt - r \cos(t + \pi/2) \\ y &= r \sin(t + \pi/2) + r, \end{aligned}$$

where R is the radius of the rolling circle and r is the radius of the circle containing the point whose path we are tracing.

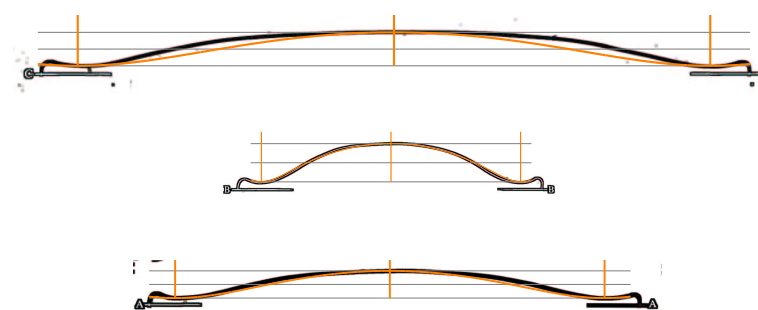


- Empirical testing suggests that the cross-archings used in most golden-period Cremonese instruments (which include those of the Amati and Guarneri families as well as Stradivari) were curtate cycloid curves [2].

Antonio Stradivari Viola, 1696 "Archinto" Back



Jacobus Stainer Violin, 1679 Back



Catenary

- A catenary curve is obtained by dangling a string from two fixed points.

$$t, a \cosh(t/a) - a$$

- We are exploring the idea that the lengthwise cross section of some violins was made from catenary curves

Amati Violin, 1628



References

- [1] Rida Farouki and Joanne Rampersad. Cycles upon cycles: An anecdotal history of higher curves in science and engineering. In M. Daehlen, T. Lyche, and L. L. Schumaker, editors, *Math. Methods for Curves and Surfaces II*, pages 95–116. Vanderbilt Press, 1998.
- [2] Quentin Playfair. Cremona's forgotten curve. *Strad*, 110(1315):1194–1199, November 1999.

Acknowledgements

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