Who's the Bás?

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Problem Introduction

- Investigate the workings of a hurl (What is a "sweet spot"?)
- Examine potential changes to the design could affect the performance

"Sweet spot"

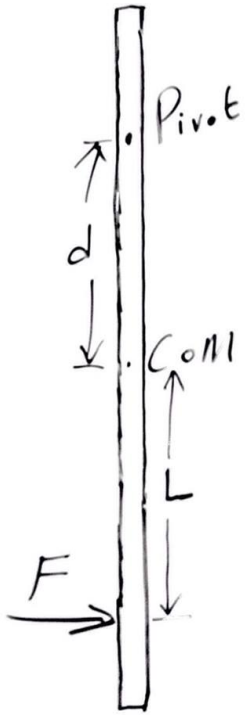
- Research done on symmetrical bats and rackets
- The **centre of percussion** is the point on an object that when hit the translational and rotational forces cancel each other out at the pivot point
- In other words there is no rebound/feedback on the arms

Center of percussion in 1-D

$$\nu_P = (\frac{1}{M} - \frac{dL}{Md^2 + I_0}) \int F dt$$

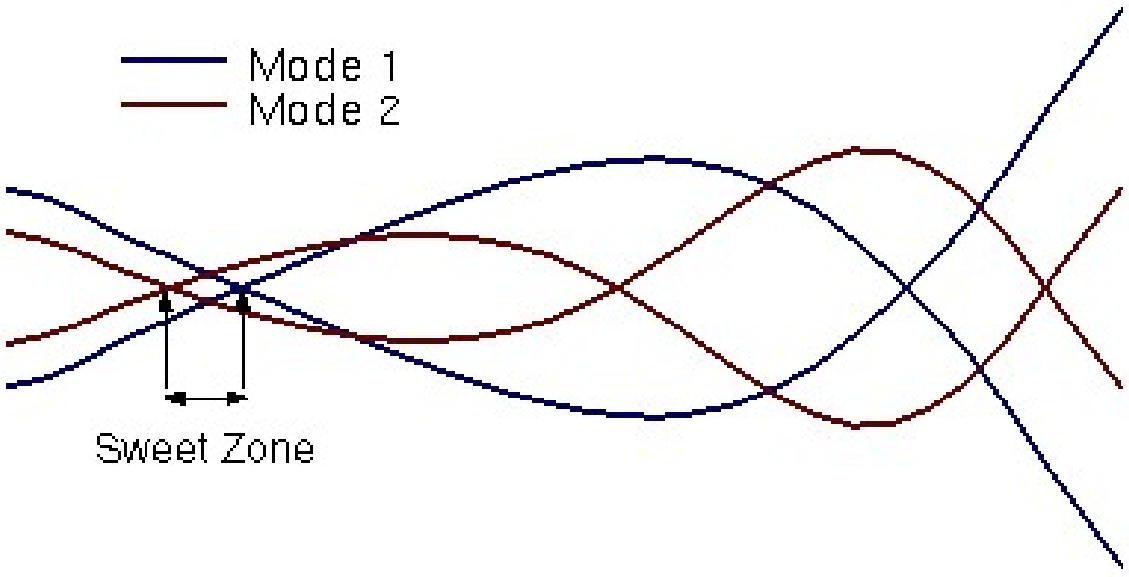
$$L = d + \frac{I_0}{Md}$$

ν_P: Speed at the pivot
M: Mass
I_0:Inertia about the center of mass



Vibrations

- Vibration modes propagate through hurl.
- At a node there is no vibration, and this distance between the modes is known as the "sweet zone".



- Combination these nodes and centre of percussion creates the "sweet spot"

Experiment

Simulation

please work

Other factors

Resin:

- Strengthens the wood and (negligibly) reduces sting
- Less friction

Metal bar:

- Increases durability
- More dangerous

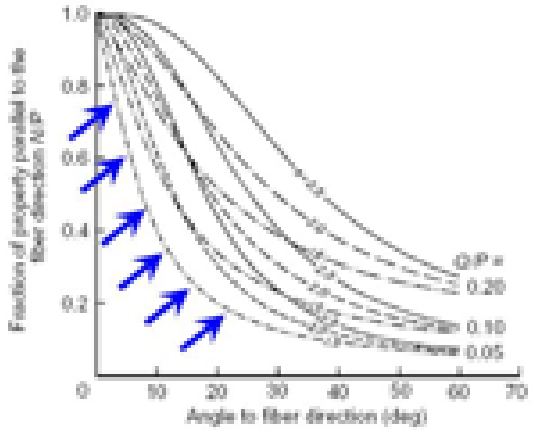
Other factors

Slope of grain:

- The slope of the grain makes a significant difference to the compressive strength of the wood
- This change is governed by Hankinson's Law:

$$\sigma_\alpha = \frac{\sigma_0 \ \sigma_{90}}{\sigma_0 \ \sin^2 \alpha + \sigma_{90} \ \cos^2 \alpha}$$

- Strength loss due to Slope-of-Grain



Plastic pretenders

- Synthetic has bigger sweet spot and less vibrations
- They are also more consistent for players

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