

Ski damping technologies: Do they really damp your skis ?

1

Context: Why is vibration damping important ?



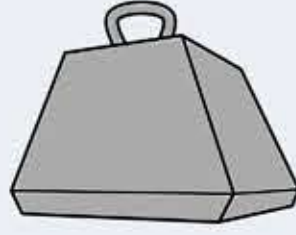
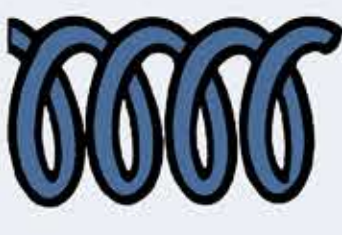
As the skier goes down the slope, his skis are **excited** by the **irregularities** of the snow [1].

By vibrating in **bending** and **torsion**, the skis are losing contact with the snow, which **reduces** the skier's **control**.

2

Hypotesis: How do ski manufacturers reduce vibrations ?

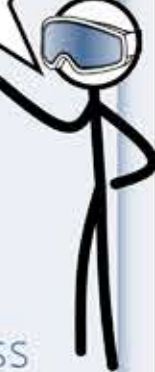
1. Increase stiffness
2. Increase mass
3. Add damping device



Secondary effects

- Less versatility
- Harder to turn
- + No effect on stiffness
- Harder to ski
- Swing weight
- + No effect on mass

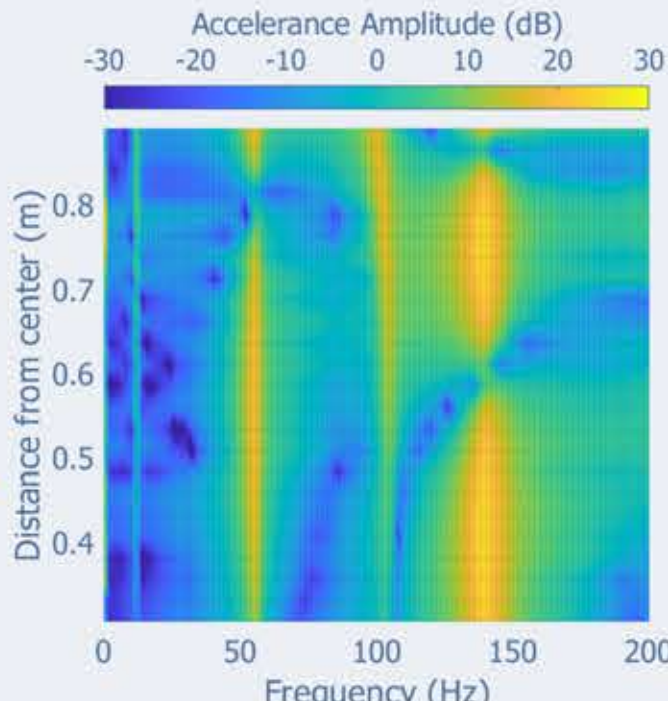
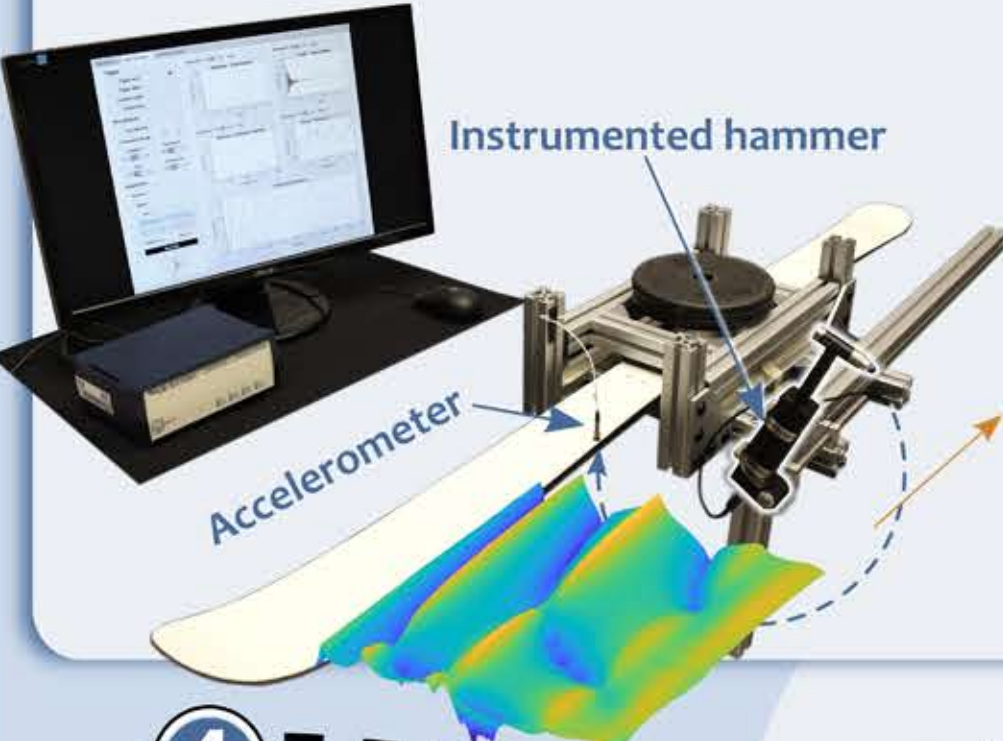
Damping devices look promising!



3

Method: How to characterize the dynamic behavior of a ski ?

A **modal analysis** can capture the **complete** dynamic behavior of a ski and an **accelerance map** can clearly show its characteristics [2]. The ski is hit with an instrumented hammer and its response is measured with an accelerometer. This method is used to characterize changes in **stiffness**, changes in **mass** and most commercially available ski **damping devices**.



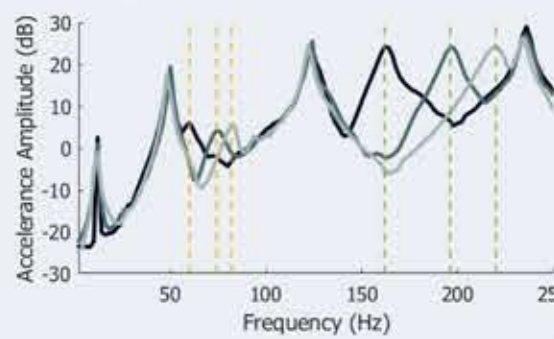
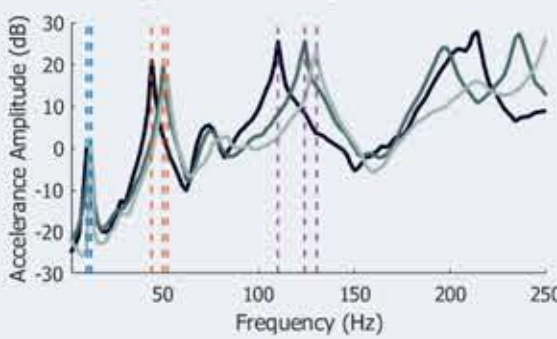
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Results: Effect of stiffness

An **increase** in **stiffness** results in a **shift** of the **resonant frequencies** of **corresponding modes**. Although it **doesn't** directly **affect** **damping**, adding stiffness **can help improve** the ski dynamic **behavior** as higher frequencies have **lower** vibration **amplitude**.

Not bad, but still no damping.

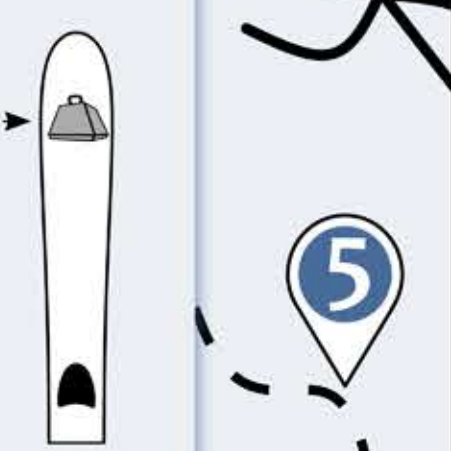
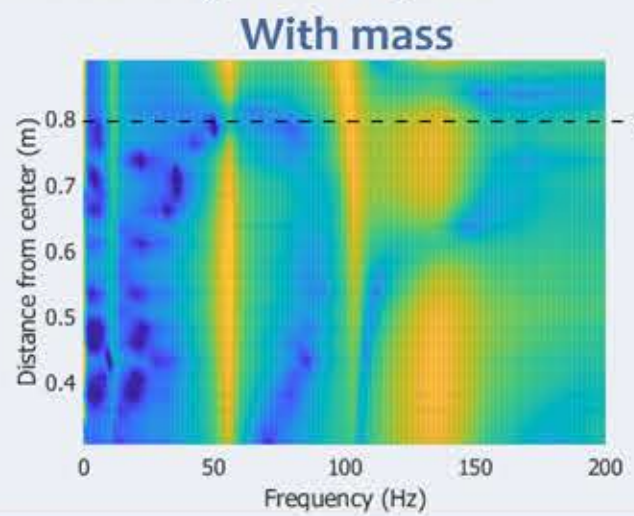
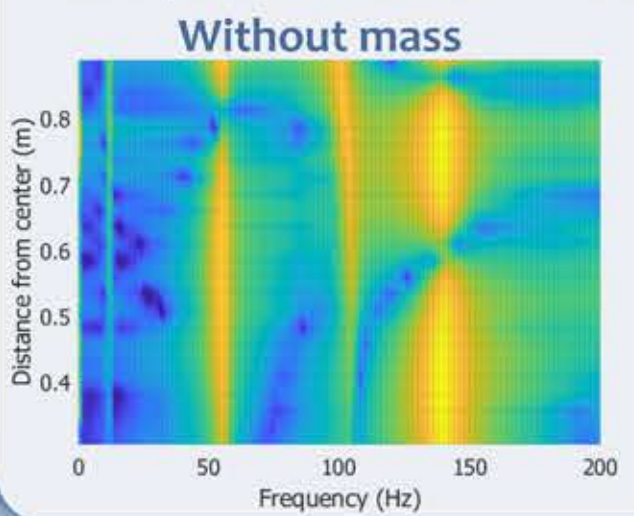
- Low Bending stiffness
- Low Torsional stiffness
- Medium Bending stiffness
- Medium Torsional stiffness
- High Bending stiffness
- High Torsional stiffness



Results: Effect of mass

A **80g mass** placed **at the tip** **increased** the **damping** properties of the ski. Only the amplitude of the bending mode at 140Hz is reduced because the mass is placed at the node of the second bending mode at 50Hz.

So simple, yet so effective!



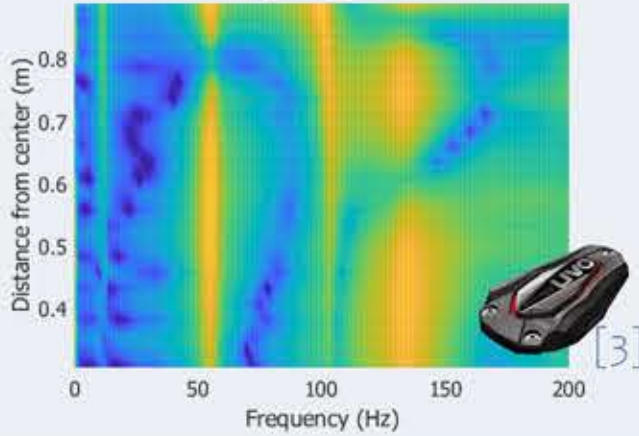
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Results: Effect of damping device

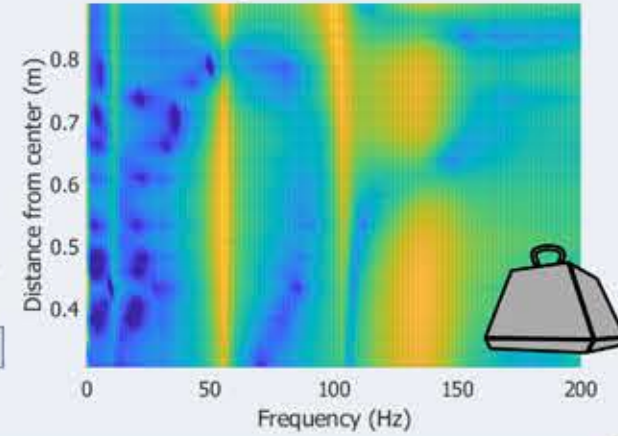
A ski is tested with a **UVO** [3] damping device and then tested again but with an equivalent mass added. The test showed **the damping properties of the device does not affect the damping** of the ski as the two maps show the same dynamic characteristics. Other **lighter devices** are tested and show **no effect** at all [4, 5].

I can't see any differences!

Damping Device



Equivalent Mass



And the winner is ?



Although it is often not desirable to **increase** the **mass** of skis, it is the **only method** to **effectively improve** the **dynamic behavior** of your skis.

References

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3. Schwantiz, S.; Griessl, W.; Lellich, C.; Krebs, R.; Winkler, B.; Odenwald, S. The effect of a Vibration Absorber on the Damping Properties of Alpine Skis. Proceedings, 2018, 2, 305
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5. Golf Shaft Extractor & Snow Ski Damper Available online: <http://www.haltzmaneng.com/golf-club-making-products> (accessed on Oct 23, 2019).

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