

**HAND ARM  
VIBRATION**



# Evaluation of vibration emission values of nailers: can an automatic test stand be used instead of human operators?

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# Presentation outline

- Background
- Objective
- Methods
- Results
- Conclusion

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# Background

- Portable nailers can generate high levels of impact noise and vibration, posing a risk for hearing loss and hand-arm vibration syndrome (HAVS).
- There is a need to identify nailers with low noise and vibration emission values (VEV) using standardized test methods.
- ISO 28927-13:2022 provides a method to assess VEV of nailers; however, it is lengthy, costly, and requires three trained operators.
- An Automatic Test Stand (ATS) has been developed to replace human operators, but it has only been validated for low-frequency vibration ( $W_h$  weighting).



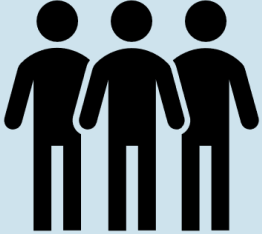



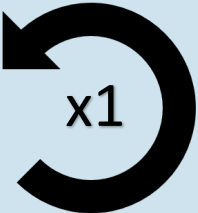
# Objective

- Evaluate the ability of the ATS to reproduce the VEV obtained with the human operators.
- Evaluate the variability of the VEV obtained with the three human operators.

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# Methods

ISO 28927-13:2022 standard				Total		
	×	 x10	×	 x5	=	150 nails
ATS	×	 x10	×	 x1	=	10 nails

# Methods

## Framing nailers

PR2  
(Pneumatic)



GB1  
(Gaz)



PB3  
(Pneumatic)



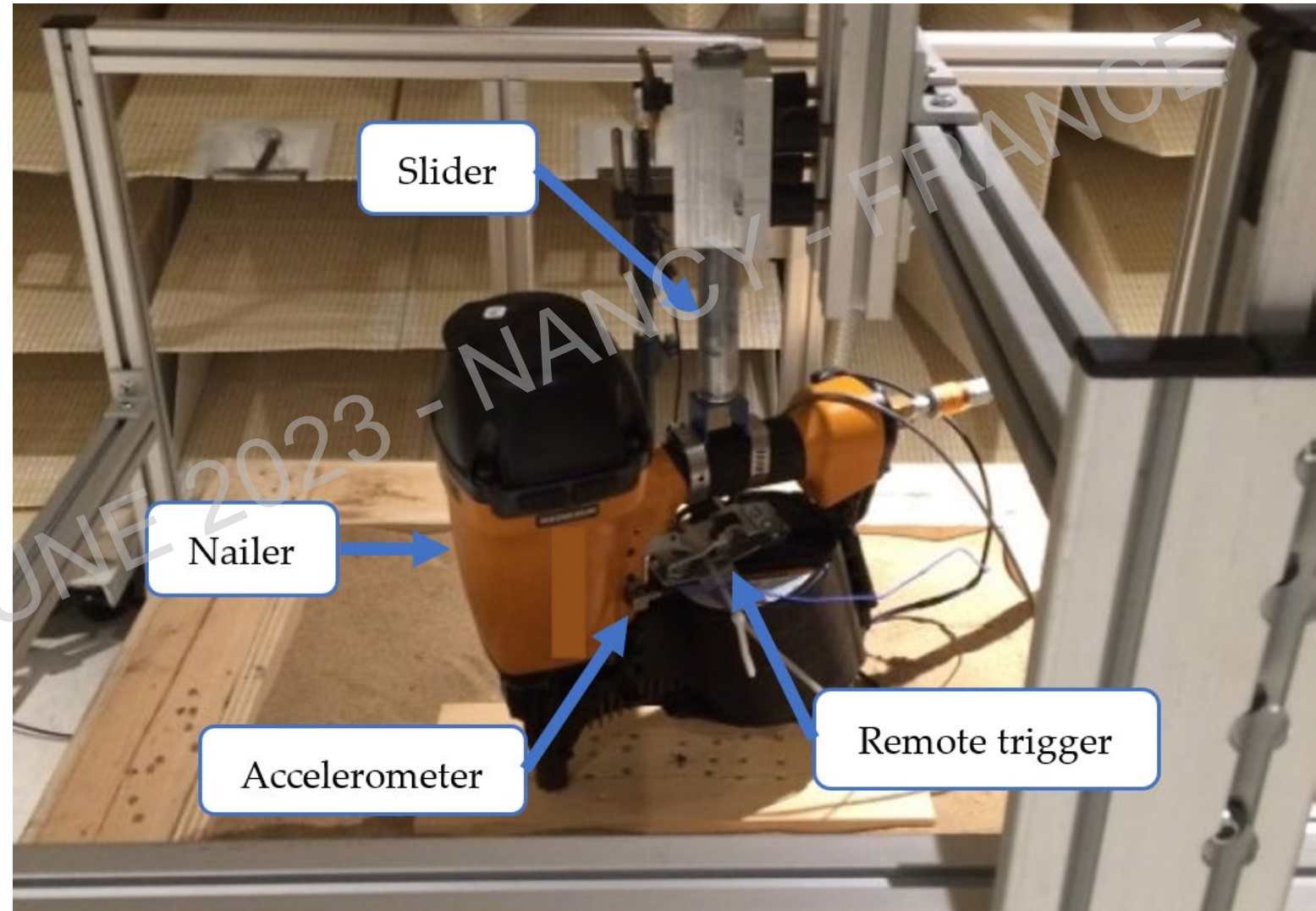
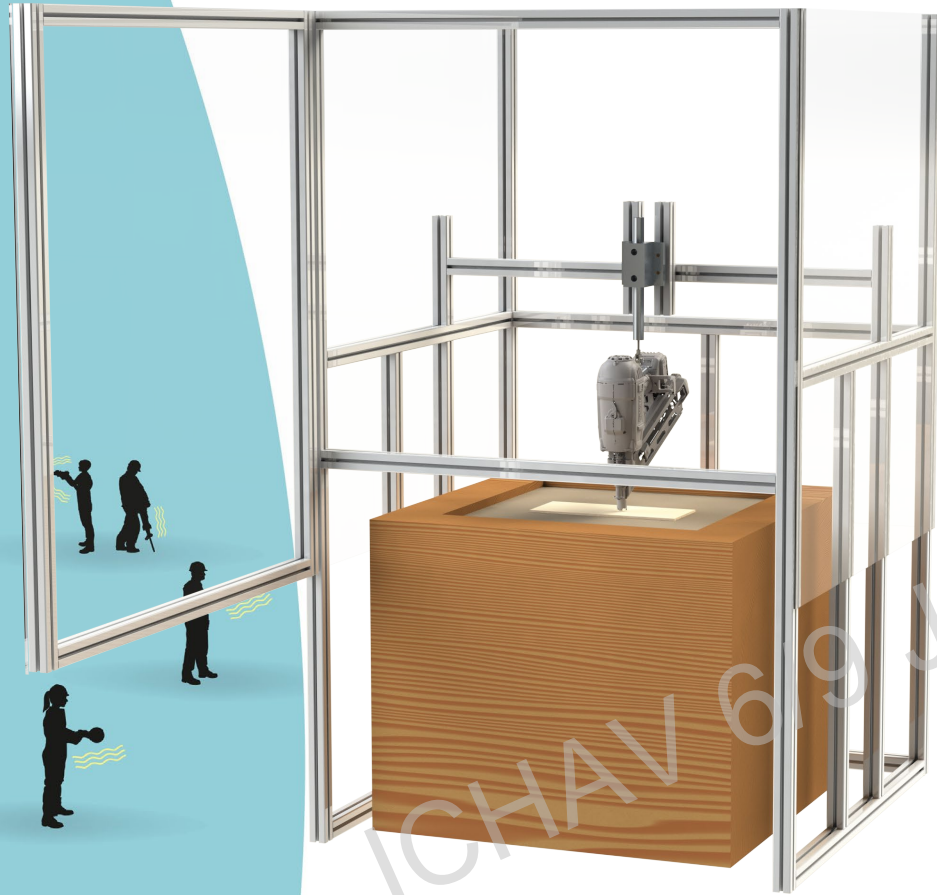
# Methods



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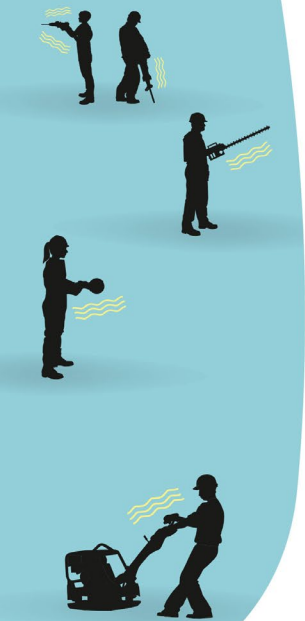


# Methods





# Methods



# Methods

Band limited «  $hF$  » frequency weighting (ISO/TS 15694:2004) to take into account the higher frequency content of hand-arm vibration:

$$a_{hF,3s} = a_{hF} \sqrt{\frac{T}{3n'}}$$

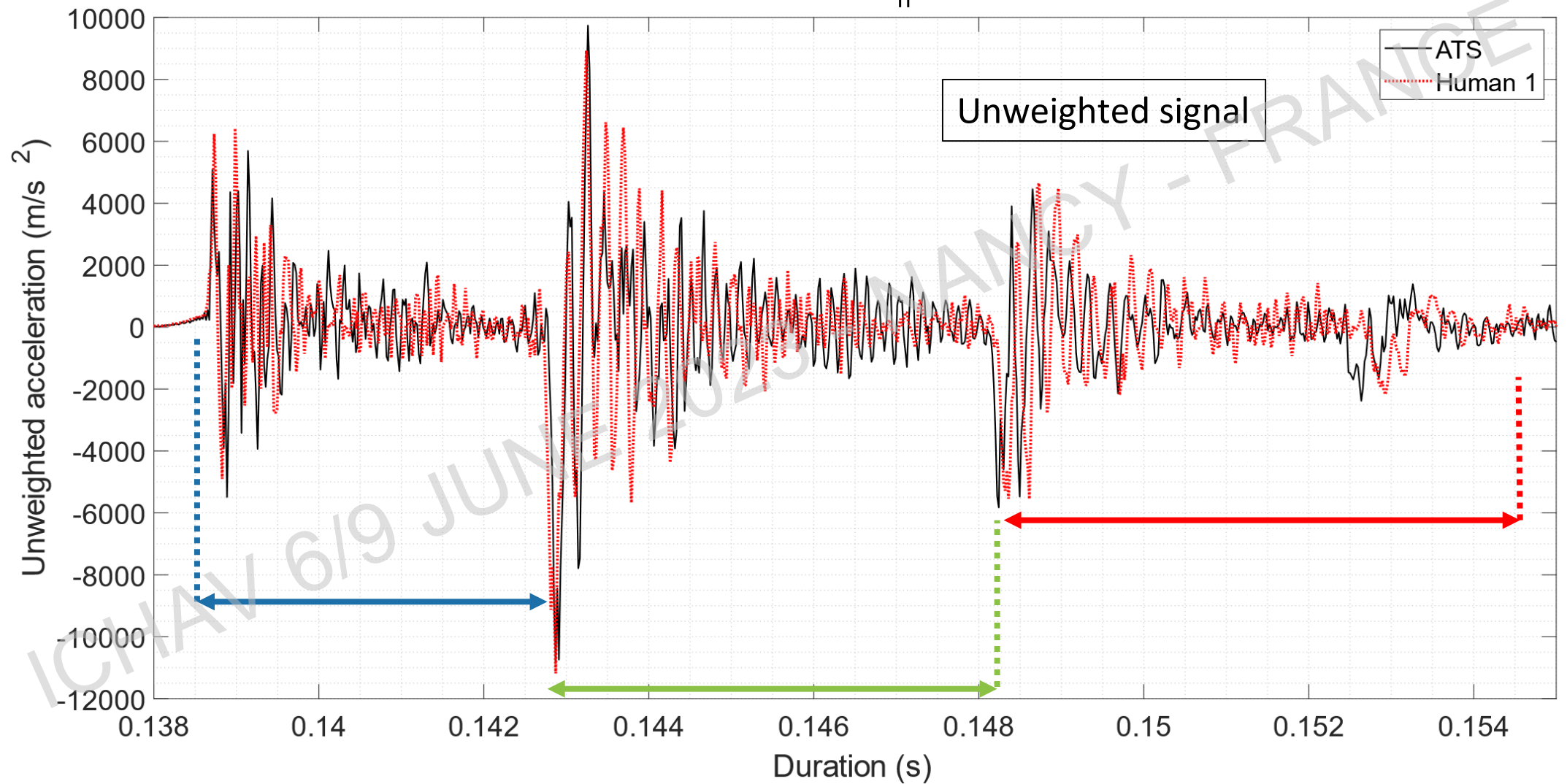
$$a_{hF,PEAK} = \max_{0 \leq t \leq T} |a_{hF}(t)|,$$

$$CF = \frac{a_{hF,PEAK}}{a_{hF,3s}}$$

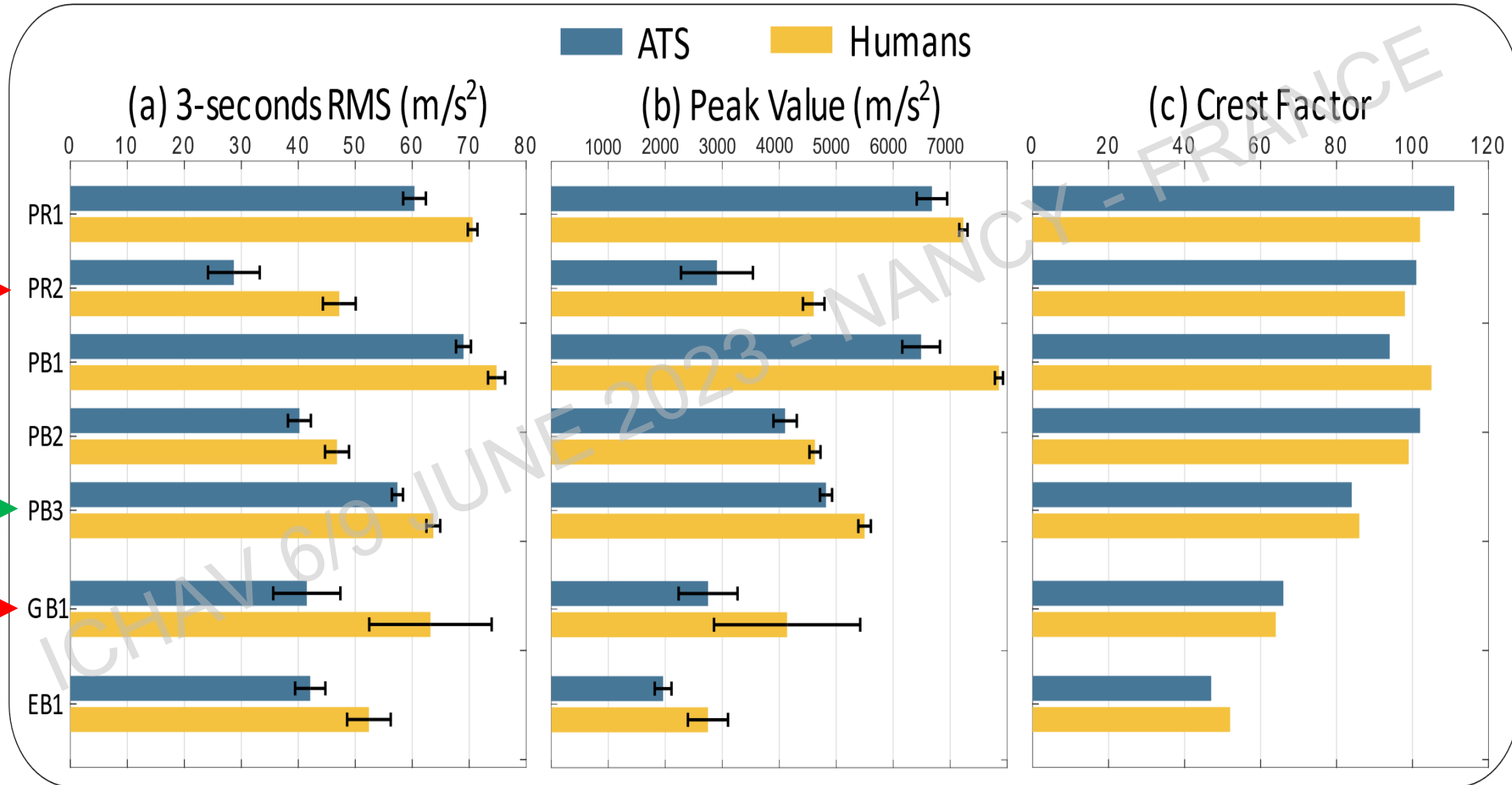


# Results

PB3 nailer ; sample rate = 51.2 kHz  
Predominant axis ( $z_h$  biodynamic)

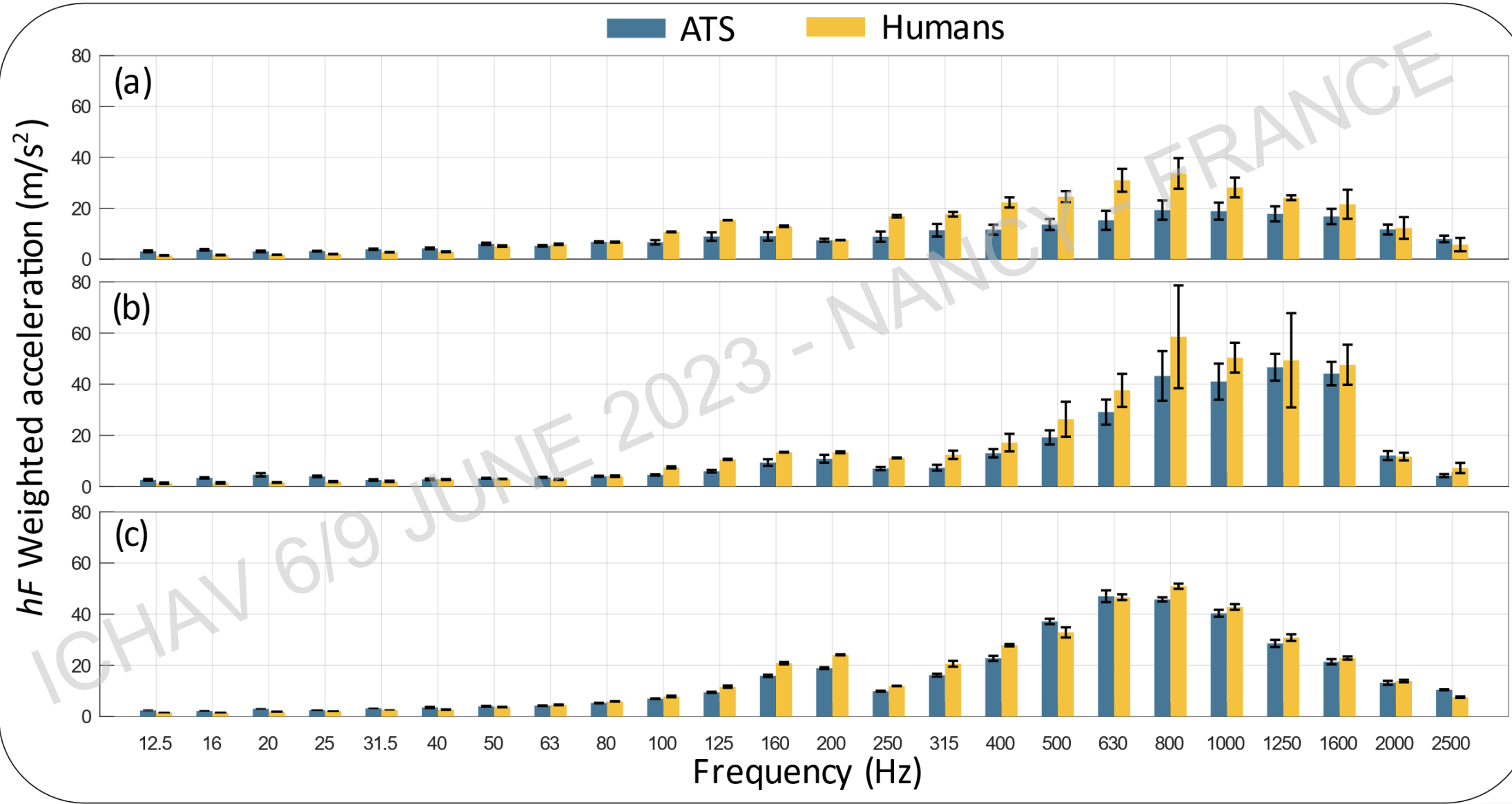


# Results



# Results

(a) PR2 nailer ; (b) GB1 nailer ; (c) PB3 nailer



# Conclusion

- The ATS appears to be a valid alternative as it simplifies the procedure and reduces the number of nails required for VEV measurement.
- Significant differences in VEV were observed between humans and the ATS for two out of seven tested nailers.
- Significant variations in VEV were observed among the three human operators: more operators are needed to characterize nailers' VEV.
- ATS needs to incorporate hand-arm biodynamics, since it could lead to underestimation of VEV.



# Thank you for listening !

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