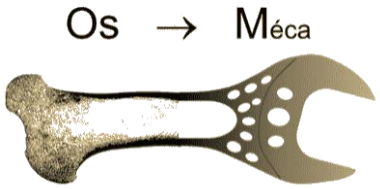
Bio-Inspired Optimization of Rhinoceros Bone Structures under Compression



Academic Year: 2025/2026

Supervisors: Julien CHAVES-JACOB (julien.chaves-jacob@univ-amu.fr) Alexandra HOUSSAYE Loïc TADRIST

Host Laboratory: The intern will be hosted by the Institut des Sciences du Mouvement (ISM) UMR7287, within the Bio-Inspired Systems (SBI) team, and will collaborate with the CNRS laboratory at the Muséum National d'Histoire Naturelle, MECADEV UMR 7179.

Internship Location: 413 avenue Gaston Berger, 13625 Aix-en-Provence, France

Duration: 8 weeks

Recommended Level: Bachelor's +4 (Master's 1st year or equivalent)

Required Skills: Computer-Aided Design (CAD), solid mechanics, finite element simulation, and experimental testing.

Summary: The project aims to draw inspiration from the internal and external structure of bones (particularly those of rhinoceroses) to design structures capable of withstanding very heavy loads. This requires a thorough understanding of the adaptive features within the bone structure of the studied organisms to inspire new designs.

The goal is to analyse the internal and external architecture of long bones from large animals and test their biomechanical properties to extract adaptive features related to supporting significant mass. The project will focus on humeri and femurs—bones that directly connect the shoulder and pelvic girdles to the limbs—and are most likely to bear "pillar-like" constraints.

This work follows a recent publication: HOUSSAYE, A., ETIENNE, C., GALLIC, Y., et al. *How can research on modern and fossil bones help us build more resistant columns?* Bioinspiration & Biomimetics, 2024, vol. 19, no. 3, p. 036007.

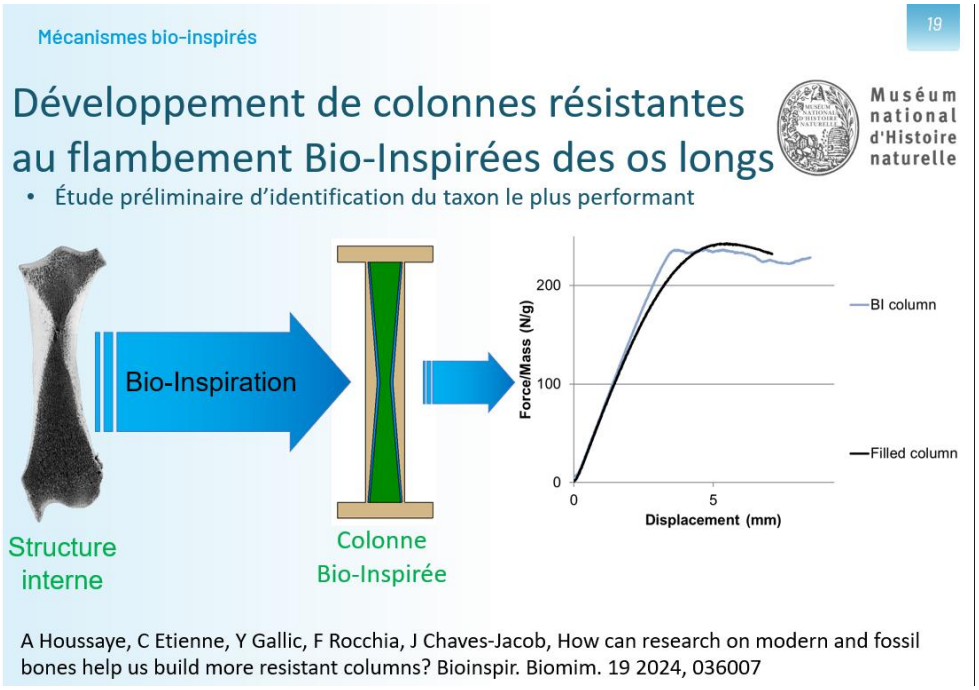


Fig. 1. Illustration of preliminary results on the bio-inspiration of long bone structures under compression.

Work Plan:

- Define CAD models of bio-inspired architectural columns
- Finite element simulation of buckling
- Additive manufacturing of these columns
- Mechanical testing to quantify the performance of these columns

To Apply: Please send a CV and a short cover letter outlining your motivation to: Julien CHAVES-JACOB (julien.chaves-jacob@univ-amu.fr)