

General information

Offer title : Three-year PhD interdisciplinary position in biomechanics and life science to study the diversity of neck forms and functions in mammals (M/F) (H/F)

Reference : UMR5242-EGLHEU-004

Number of position : 1

Workplace : LYON 07

Date of publication : 14 May 2025

Type of Contract : FTC PhD student / Offer for thesis

Contract Period : 36 months

Start date of the thesis : 1 October 2025

Proportion of work : Full Time

Remuneration : 2200 gross monthly

Section(s) CN : 29 - Biodiversity, evolution and biological adaptations: from macromolecules to communities

Description of the thesis topic

The neck emerged concurrently with limbs in tetrapods during the vertebrate water-to-land transition in the Devonian (around 400 MY ago) and facilitated the conquest of the terrestrial habitat. An elongated cervical system, that permits moving the head independently from the body towards sensory cues, greatly diversified in reptiles but had been stabilized early during mammalian evolution at seven vertebrae. Given this low number, an unexpectedly high degree of shapes, functions and modularity of the mammalian neck has been reported to adapt to various environments or locomotion modes.

The proposed PhD project will aim to relate mammalian neck shapes to functions and adaptations by combining comparative anatomy approaches and morpho-functional analyses in extant small mammals adapted to various environments, with different neck shapes and motion capacities (mouse, mole, rabbit, mouse lemur). An initial fine geometrical reconstruction of the neck musculoskeletal system in the different species will be performed using X-ray μ CT scans, allowing for a first step of morpho-functional assessment. Kinematic analyses in adult specimens will then be performed using X-ray cineradiography to correlate the neck musculoskeletal system shapes to motion performance and functions. This study will permit to perform computational biomechanical modeling of the neck musculoskeletal system and will constitute an entry point to extrapolate on the shape and function of the neck in extinct mammals of the fossil record and will also offer perspectives in the field of bio-inspired robotics.

References

Heude et al. (2024) Co-option of neck muscles supported the vertebrate water-to-land transition. Nat. Comm. <https://www.nature.com/articles/s41467-024-54724-x>

Reghem et al. (2013) Unconstrained 3D-kinematics of prehension in five primates: Lemur, capuchin, gorilla, chimpanzee, human. J. Hum. Evol. <https://doi.org/10.1016/j.jhevol.2013.06.011>

Taverne et al. (2023) Form–function relationships underlie rapid dietary changes in a lizard. Proc. Roy. Soc. B. <https://doi.org/10.1098/rspb.2023.0582>

Work Context

The PhD is funded by an interdisciplinary 80 PRIME PhD fellowship from the CNRS MITI involving multiple partners with complementary skills. The PhD will be completed under the co-supervision of 1) Dr. Eglantine Heude (coordinator), head of the newly-formed team 'Developmental and Evolutionary Histories of Vertebrates' at 'Institut de Génomique Fonctionnelle de Lyon' (IGFL, ENS Lyon) and 2) Pr. Laurence Chèze, deputy director of the 'Laboratoire de Biomécanique et Mécanique des Chocs' (LBMC, UCBL/Univ. Eiffel). The project will be conducted in close interaction with Dr. Bertrand Fréchède (LBMC, UCBL/Univ. Eiffel) specialized in the biomechanical modeling of the cervical musculoskeletal system, and Dr. Anthony Herrel (MNHN Paris), expert in X-ray kinematic acquisitions and morpho-functional analyses.

The candidate is required to enrol within the « MEGA » (ED162) doctoral school as part of his/her PhD studies, and will benefit from its multidisciplinary training offer.

We seek highly motivated students with an excellent track record, having graduated a MSc degree (or equivalent) in Biomechanics; or combining solid backgrounds in either Mechanics (eg. if applying with a major in Computational life sciences) or Life sciences (eg. if applying with a major in Mechanics or Mechanical engineering). The tasks will involve eg. image processing, computer graphics, data fusion, kinematic modeling, statistics ... and some proven knowledge in these fields and their related methods and tools will thus be a strong plus. Finally, good writing and communication skills in English are required.

Constraints and risks

The PhD candidate will be hosted in Lyon at the IGFL and LBMC and will start on October 1st, 2025 (not negotiable). The PhD will have to complete several funded missions for a few days in Paris along his/her contract for X-ray kinematic acquisitions and morpho-functional analyses in the lab of A. Herrel (MNHN), a major partner of the present PhD project.

Application: <https://emploi.cnrs.fr/Offres/Doctorant/UMR5242-EGLHEU-004/Default.aspx?lang=EN>