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MULTIBODY SIMULATIONS OF DIPLODOCID TAIL MOTION

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Sauropod dinosaurs are iconic animals known for their elongated necks and tails, with an evolutionary history that spanned from the Triassic up to the end of the Cretaceous. Their body plan remained largely unchanged during all this time with minor adaptations in certain subclades. The elongated tail evolved as a counterbalance to the long neck but was probably coadopted for other purposes, as well, at least in some clades, as e. g. Flagellicaudata. Since the discovery of the first flagellicaudatan tails in the late 1800s a defensive use was proposed for the tails, due to their morphological resemblance to bull-whips. However, this hypothesis has been tested only by two computer simulations in the 1990s. Here we propose new computer simulations performed with ADAMS software. Two simplified tail models were tested, one inspired by data previously used in the literature which are most similar to apatosaurine tails, and a second model, based on data obtained from diplodocine tails. The two models have a total length of 12,34m, composed of 82 rigid bodies representing the vertebrae, connected by revolution joints in order to perform a multibody simulation to estimate the maximum velocity achievable by imposing a rotation at the first eight vertebrae of the tail. The analyses show that both models were able to surpass the speed of sound and that the different morphologies strongly affect the results, with the diplodocine tail tip reaching up to four times higher velocities than the apatosaurine one while being subjected to the same input. This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS/CCCDI – UEFISCDI, project number PD 136 /2020, within PNCDI III (to AAS).