

Performances of the avian body design – X-ray video analysis of the bird bipedal locomotion

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Birds are very diverse, both in the number of species and their ability to live in various environments. Despite this ecological plasticity, the bauplan of these animals is very conservative and corresponds to specializations for flying that marks the bird's morphology. This specialization necessitates wings and a rigid trunk. Besides these specializations for flying, birds are fundamentally bipeds. This feature, basal for the clade, allows them to move on most substrates without profound modifications of the avian bauplan. The only other strictly biped species, humans, is not capable of such locomotor plasticity. The question we address here is the link between the geometrical features of the bird bauplan and the performances of these bipeds. The comparison of the kinematics of the body parts during different locomotor behaviors: walking, swimming, hopping, and taking off, is a way to assess this question. However, feathers hide the body and X-ray analysis is needed to quantify the movements of the underlying skeletal elements. The trajectories of the bones indicate that two functional modules participate to the locomotor plasticity, the trunk and thigh jointly control the path of the center of mass, and the distal part of the legs propels the system. A kinematic model of the avian limb is compared to the human one. A comparison of the evolutionary trajectories of both bipeds is used to understand the origin of the differences between them.