The RoboCoq Project : Modelling and Design of a Bird-like Robot Equipped with Stabilized Vision

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Abstract

The RoboCoq project aims at designing a prototype of autonomous biped based on the avian model. According to biological studies conducted at National Museum of Natural History in Paris (MNHN) the locomotion system of birds appears to be more efficient than the human model in terms of stability, stride length (see table below) and mobility.

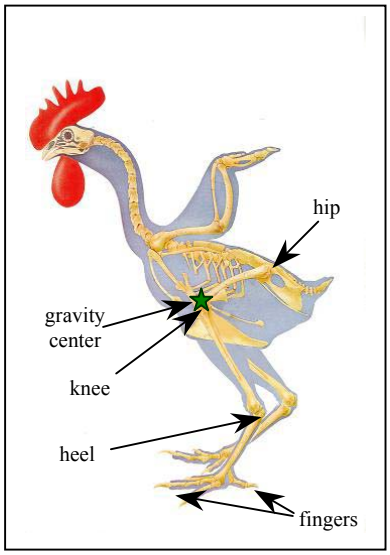
features	*Human*	*Bird (quail)*
Stride length	100 cm	20 cm
Hip height	100 cm	9 cm
Ratio (stride length / hip height)	1	2.2

Birds are the only animals to share a strict bipedy with humans. Several characteristics suggest that the avian model is more stable than the human model. As a matter of fact the centre of gravity is located under the hip joint (see figure) whereas among humans it is located above in the lower part of the trunk. Among birds the trunk is suspended by the hip joints.

The hind limb of the birds is characterized by the presence of three segments. The first one that joins the hip and the knee joints is nearly horizontal and allows for bringing back the leg below the gravity centre. It may also plays the role of a stabilizer of the trunk. The two other segments are the most mobile parts.

The "foot" of the birds is primitively formed by four fingers only, with three toes pointing forward and one pointing backward. It is therefore much simpler than the human foot. The flexibility of the 4 fingers and the large base they form allow high stability, even on irregular ground.

The objective of this project is to design a robot capable of exploring cluttered environments and returning visual feed-back to the operator at a remote location. For this purpose the robot should also be equipped with a stabilized vision system that will be inspired by the head-bobbing reflex used by birds to stabilize images on their retinas. The design of the robot will rely on experimental kinematic and dynamic data obtained from the animal. The information collected will serve as a basis for modelling and simulating the locomotion system of the bird, and will help reproduce the head-bobbing reflex on the robot.



Rooster skeleton showing leg joints
Modified from De Juana (1992)