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A THREE-DIMENSIONAL MODEL OF THE DOG'S LOCOMOTOR SYSTEM

Heiko Stark, Emanuel Andrada, Martin S. Fischer

Friedrich Schiller University Jena, Germany
heiko@starkrats.de

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Summary: Dogs are an interesting object of investigation due to their different body sizes (chihuahua – great dane) and their variable body type (sighthound – bulldog). Interestingly, the connections between body structure and joint load during locomotion, as well as between joint load and degenerative diseases of the musculoskeletal system (e.g. dysplasia) are not sufficiently investigated and understood. Above all, we want to understand how body size, physique and agility as well as diseases affect the gait-related mechanics and control of the joints in dogs. To understand joint load, a simulation model was used for the evaluation of the internal and thus invisible power transmission.

This requires the exact morphometric data of the skeleton. For the indirect calculation of muscle activities, the description of the muscles via a muscle model is needed. We used the open source software "OpenSim" to create the model. For the construction of the model we used computer tomography (CT) data of a beagle and an available digital musculoskeletal reconstruction based on cadaver data of a shepherd dog. CT data were used to reconstruct the skeletal elements and care was taken to get a precise representation of the muscle attachment points. In addition, the masses, moments of inertia, and centre of rotations were calculated from the CT data. Furthermore, boundary conditions have been included to prevent the muscles from penetrating the bones. The model is fully 3D and include 67 muscles per side. The result is a model that can be used to verify EMG data or generate new data insights.

The model is now being checked for plausibility and with external data. Because the model is scalable, we will be able to better understand the control and load of the joints on the locomotion of dogs. Therefore, we have collected kinematic and kinetic data of more than 20 dogs with different physiques (beagles, whippets, french bulldog, mallinois) at walk, trot, gallop, and different jumps.