

## THREE-DIMENSIONAL FORELIMB KINEMATIC ANALYSIS OF TAMANDUA TETRADACTYLA DURING WALKING, CLIMBING AND BALANCING



A. Scheidt\*, S. M. Geiger+, F. C. Wagner•, C. K. W. Mülling• & J. A. Nyakatura\*

\* Humboldt University of Berlin <sup>+</sup> University of Veterinary Medicine, Vienna
• University of Leipzig

# Background

Tamanduas utilize a diverse set of locomotor behaviours. Being excellent climbers , they also exhibit morphological adaptations to hook-and-pull-digging. As members of the Xenarthra, they belong to a sister-clade to all other eutherian mammals, which makes them intriguing study animals for research on adaptation and evolution in locomotion in mammals.

We used the marker-less X-ray of moving morphology (XROMM) method to visualize and quantify the three-dimensional movements of the **scapula**, **humerus**, **ulna**, and **radius** of two adult individuals.

### 1. Fluoroscopy

Biplane X-ray videos were recorded during different locomotor behaviours: Walking on a level treadmill, climbing a vertical wooden pole, and balancing on a horizontal wooden pole.



#### 2. Photogrammetry

3-D surface models for each bone were created using photogrammetry. In photogrammetry mages of various angles of the object are combined to create a point cloud which can then be used to create a surface model.



#### 3. Scientific Rotoscoping

The bones were combined to form a digital hierarchical marionette. The marionette was then oriented in such a way that the bone models matched the X-ray shadows of the bones in each X-ray video frame.

Fig. 3: Animated bones were matched to each frame of the obtained X-ray videos to create a moving model.







References

Gatesy, S. M., Baier, D. B., Jenkins, F.A. & Dial, K. P. (2010). Scientific rotoscoping: A morphology-based Method of 3-D motion analysis. J Exp Zool. 313A, 244-261.

Nyakatura, J. A. & Fischer, M. S. (2010). Three dimensional analysis of the pectoral girdle during upside-down locomotion of two-toed sloths (Choloepus didactylus, Linné 1758). Front. Zool., 7: 21.

Taylor, B. K. (1978). The anatomy of the forelimb in the anteater (Tamandua) and its functional implications. J. Morph. 157: 347-368.

#### 4. Outlook

The resulting animation allows to measure 6 degrees of freedom movements of the scapular fulcrum, the glenohumeral joint, the humeroulnar joint and the humeroradial joint. Based on this data for the first time the complex kinematics of tamanduas will be described during different locomotor behaviours (walking, climbing, balancing). Additionally, a joint movement's contributions to the overall movement will be quantified.

> **Funding** The Nyakaturalab is funded by the german research council (DFG EXC 1027).

