Assessment of the master thesis by Valeriia Iegorova

Reconstructing 3D Models of Animals

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thesis supervisor

The goal of the thesis was to investigate approaches to 3D reconstruction from images and 3D data relevant for reconstructing non-static animals.

Reconstructing animals in real situations is very complicated since they are highly articulated non-rigid 3D bodies. Classical passive 3D structure from motion (SfM) reconstruction methods from multiple images fail in this task due to the non-rigidity of animals and lack of reliable local features for image matching. Existing generalizations of SfM methods for non-rigid objects fail as well. They lack robustness for practical use. Using active 3D reconstruction methods based on lidars and time of flight sensors is also challenging due to the need to operate outdoors under the direct sun. Recent advances in machine learning spawned several different approaches that use trained models to extract dynamic objects from images based on learned priors. Such advances open new ways to overcome shortages of classical methods. However, none of the existing methods have completely solved animal reconstruction under realistic conditions, which is the topic of the thesis.

The thesis of Valeriia Iegorova brings several contributions.

First of all, an extensive literature review is provided. Many rigid and non-rigid object reconstruction techniques from passive and active sensors are reviewed. Particular attention is devoted to the methods for modeling wild and domestic animals using machine learning and available data sets for training. The review is very well written, is complete, and presents an excellent review of the art in animal modeling.

Secondly, the thesis provides a very interesting set of experiments with classical 3D reconstruction methods based on images and RGBD data, e.g., Reality Capture and Scaniverse, and methods based on trained (parametric) models, e.g., SMALST and WLDO. Based on this analysis of previous work and experiments, the thesis selects the most promissing previous approaches and data sets to build further on. This is an example of an excellent research methodology.

Finally, the thesis proposes a new method, SMAL4V, which extends previous single-view methods in the SMAL family and WLDO method to multiple images and video sequences. The new method has been implemented and tested on single-view and multi-view data sets in an online learning setup. The method shows promising results that give hope to delivering a practical solution when sufficient training data is used.

Valeriia was an excellent independent student. She worked very actively and brought her ideas on what and how to try. I believe that her work presents an excellent example of high-quality engineering work based on understanding the state of the art, well-chosen experiments, and drive to arrive at practical engineering solutions. She fulfilled all the goals set in the assignment and presented a new approach to solving a challenging problem in non-rigid 3D reconstruction.

The master thesis is excellent, and thus I grade it as excellent (A).

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