PhD Proposal: Animating 3D antique statues and engravings

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Figure 1: Examples of antique statues (left:real model, right: virtual model) wearing clothes that could be animated within this project.

1- General context and objective

Antique statues and engraving in rocks are fascinating pieces of history which survived through time. They depict both shapes and ancient lifestyle as seen in Fig. 1. Although constrained to be engraved as a single static shape, these art works commonly illustrate living animated scenes and therefore contain intrinsic visual information about animated story scenarios.

The objective of this PhD is to take advantage of such visual information and 3D acquisition of real antique data from museums, to deform and animate a virtual reproduction of antique statues and engravings. In being able to bring life to these 3D model, in accordance with the antique lifestyle, this work would help to enhance attractiveness to antique history to the general public.

2- Methodology

While 3D scanning method is able nowadays to acquire the geometry of existing antique statue with high precision, generating the deformation and the animation of such virtual statue remains a scientific challenge. Indeed, the deformation should be applied on the character skin geometry which is not visible as statues are generally wearing cloth layers such as long covering tunics. Entire parts of the model may also be missing, as they may not exists anymore on the real model, or related to the engraving process which doesn't depicts a fully 3D scene. The static model must further be made compatible with animation parameters, also called rig, in order to be deformed in a plausible manner, and lead to a dynamic animated antique scene. To tackle these challenges, we

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will develop in this PhD project the following contributions.
First, we will develop a semi-automatic approach to **infer the hidden body geometry** under the clothes and ornaments from the available surface information. We will need to detect and classify region of the input mesh surface as skin, clothes, or other ornaments in using possibly geometrical curvature analysis as well as a priori knowledge and user annotations. Once categorized, the underlying skin surface geometry will need to be computed and can be inspired in developing for instance surface synthesis approach, or using an adapted template mannequin model [BB08, GCZZ12].
Second, the static character model will be **rigged** in order to be deformed, i.e. associated with an embedded skeleton linked to the skin surface through skinning weights. This rigging part is usually designed *by hands* by skilled computer artists, and should instead be computed in a more automatic manner from the pose in which the statue has been captured [BP07, PYX+09, BTST12, GCR13]. The other objects, ornaments, and garments of the character will further need to be efficiently associated to the character and animated accordingly [RPC+10].
Third, an **animated scenario** will be infered and authored from both clues provided by the static scene depiction and knowledge on antique lifestyle as well as the development of dedicated annotation inspired from storyboarding conventions, such as textual content [RS14] or visual annotation primitives [GIZ09, GRGC15], allowing to play meaningful antique scenarios.

References

[BB08] Alexandru O. Balan and Michael J. Black. The Naked Truth: Estimating Body Shape Under Clothing. *European Conference on Computer Vision (ECCV)*, 2008.

[BP07] Ilya Baran and Jovan Popovic. Automatic Rigging and Animation of 3D Character. *ACM Transactions On Graphics, Proc. ACM SIGGRAPH*, 26(3), 2007.

[BTST12] Gaurav Bharaj, Thorsten Thormählen, Hans-Peter Seidel, and Christian Theobalt. Automatically Rigging Multi-component Characters. *EUROGRAPHICS*, 31, 2012.

[GCR13] Martin Guay, Marie-Paule Cani, and Rémi Ronfard. The line of action: an intuitive interface for expressive character posing. *ACM Transactions on Graphics (Proc. ACM SIGGRAPH Asia)*, 32(6), 2013.

[GCZZ12] Yu Guo, Xiaowu Chen, Bin Zhou, and Qinping Zhao. Clothed and Naked Human Shapes Estimation from a Single Image. *Computational Visual Media*, 2012.

[GIZ09] Yotam Gingold, Takeo Igarashi, and Denis Zorin. Structured annotations for 2D to 3D modeling. *ACM Transactions on Graphics, ACM SIGGRAPH*, 28(5), 2009.

[GRGC15] Martin Guay, Rémi Ronfard, Michael Gleicher, and Marie-Paule Cani. Space-time sketching of character animation. *ACM Transactions on Graphics (Proc. ACM SIGGRAPH)*, 34(4), 2015.

[PYX+09] Junjun Pan, Xiaosong Yang, Xin Xie, Philip Willis, and Jian Zhang. Automatic rigging for animation characters with 3D silhouette. *Computer Animation and Virtual Worlds*, 20, 2009.

[RPC+10] Damien Rohmer, Tiberiu Popa, Marie-Paule Cani, Stefanie Hahmann, and Alla Sheffer. Animation Wrinkling: Augmenting Coarse Cloth Simulation with Realistic-Looking Winkles. *ACM Transactions on Graphics, Proc. ACM SIGGRAPH Asia*, 29(5), 2010.

[RS14] Rémi Ronfard and Nicolas Szilas. Where story and media meet: computer generation of narrative discourse. *Computational models of Narrative*, 2014.

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3- Position information

Research team
The PhD will take place within the Inria Grenoble research center, in the Imagine research team, part of Laboratoire Jean Kuntzmann (CNRS), developing knowledge-based models for shapes, motion, stories and virtual cinematography.

Funding
The PhD position is funded by the ANR, under the eRoma project. A budget for equipment and travels accompanies the position.

Collaboration
This project is developed in collaboration with the University of Lyon – LIRIS, the Musée Gallo-Roman de Lyon, and the Paris-Sorbonne University. Frequent collaborative meetings will be conducted, notably with Raphaelle Chaine and Julie Digne, from Geomod-LIRIS. Several meetings to the Musée Gallo-Roman de Lyon are also expected.

Within the same ANR project, another PhD project will be conducted in parallel in Lyon, in order to specifically process the raw laser acquired data of the statues and engravings to export a fully reconstructed static mesh surface. In this other PhD, missing parts of the characters will notably be completed according to existing geometry, antique knowledge, and possibly using a data base of parameterized object models.

Start and duration
The PhD is expected to start between Sept-Nov 2017, for a 3 year period.

Candidate profile
The applicant must hold a Master's degree in Computer Science with a working knowledge of computer graphics, notably in geometrical modeling and computer animation. Good programming skills are also expected.

Application procedure
Application should be sent to one of the persons listed below by submitting a detailed resume, cover letter, grade of the two years of Master degree, and provide the name of a supervisor and/or professor who knows you and could support your application.

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