# Texturing and Deforming Meshes with Casual Images

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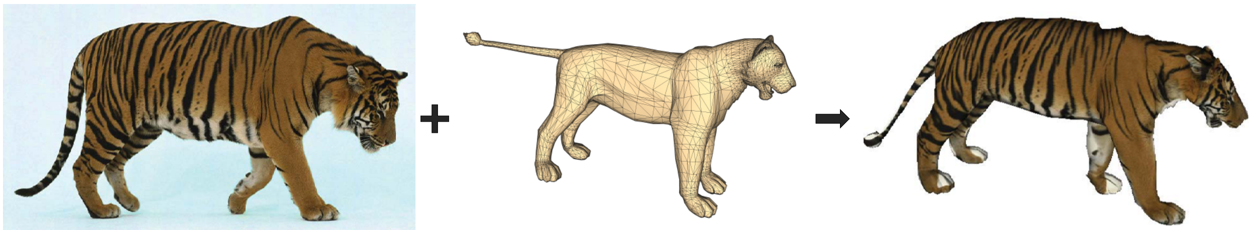

Source image Input model Result

**Figure 1:** *Overview of our method. Given a casual image obtained from the Internet, and a triangle mesh model, we compute the texture mapping and shape deformation interleaving. This example uses a tiger image downloaded from the Internet with low tails, and its head face to the ground, but the model originally has straight tail in the air, and facing to the front. The output is a model not only textured by the casual image, but also fit the shape of the tiger image.*

## 1 Introduction

Using images to texture 3D models to create realistic 3D models is an important task in computer graphics. However, if the object shape of the casual image is not similar to the target model, the textured model would be strange since the image is severely distorted. In this extended abstract, we present a novel texturing and deforming approach for mapping the texture and object shape of a casual image to a 3D model simultaneously based on an alternating least-square approach. Through a photogrammetric method, we project the target model onto the source image according to the estimated camera parameters.Then, the target model is deformed according to the object shape of the source image while minimizing the image distortion. The processes are performed iteratively.Our method can achieve texture mapping, shape deformation, and detail-preserving at once, and can obtain more reasonable texture mapped results than traditional methods.

## 2 Texturing and Deforming Models

The input are a casual image $I$, a 3D template model $M = (V, E, F)$, and a set of corresponding feature points $\{(p_i, v_i)\}_{i=1\ldots P}$ provided by the users, where $p_i \in I$ and $v_i \in M$. We seek the optimal deformed vertex positions $V'$ and the local camera projection model [Tzur and Tal 2009] for each vertex such that the shape and texture distortion is minimized. We formulate it as an optimization problem, and the overall objective function of the texturing and deformation process is defined as:

$$E = \alpha \sum_{i=1}^{N} \sum_{j=1}^{P} E_p(v_i, v_j) + (1-\alpha) \sum_{i=1}^{N} E_l(v_i), \qquad (1)$$

where $E_p$ is the feature correspondence term and $E_l$ refers to the geometry preserving term, $\alpha = 0.5$ is a weight for balancing the two terms, and $N$ is the vertex number of the mesh model $M$.

**Feature correspondence term.** The first term of the objective function Eq. (1) is used for penalizing the matched feature misaligned, which is defined as:

$$E_p(v'_i, v'_j) = \frac{1}{\varepsilon + D(v'_i, v'_j)^{\beta}} \|\mathbf{M}_i v'_j + c_i - p_j\|^2, \qquad (2)$$

where $D(v'_i, v'_j)$ is the geodesic distance between the two vertices $v'_i$ and $v'_j$ on the deformed mesh, $v'_j$ and $p_j$ are the corresponding feature points on the deformed mesh and the image $I$, respectively. We solve for the unknown vertex positions $V'$ and projection matrix $\mathbf{M}_i \in \mathbf{R}^{2\times 3}$ and the translation scalar $c_i \in \mathbf{R}$ for each vertex $v'_i$ on the deformed mesh.

**Geometry preserving term.** We would like the deformed model to be similar to the original model. Hence, we penalize the Laplacian coordinate differences between the original and deformed models. The energy term is defined as

$$E_l(v_i) = \|L(v'_i) - L(v_i)\|^2, \qquad (3)$$

where $v'_i$ is the deformed vertex position, and $L(\cdot)$ is the Laplacian coordinate as introduced in [Sorkine et al. 2004].

Note that both the vertex position $V'$ and the local projection model $\mathbf{M}_i$ and $c_i$ are unknown, and the latter depend on the vertex positions. Therefore, we iterate between fixing $V'$ and solve for $\mathbf{M}_i$ and $c_i$, and then fixing the updated $\mathbf{M}_i$ and $c_i$ to solve for $V'$ until convergence.

## 3 Conclusion and Future Work

We present a novel framework for texturing the casual image onto the 3D model, and exploiting the shape of the image object to deform the model. In the future, we would like to accelerate the process parallel with GPU, and utilize skeleton information to improve the deformed and textured result.

## References

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