# Quadrangulation through Morse-Parameterization Hybridization, ACM SIGGRAPH '18

*Addendum: Tests on Thingi10K Dataset*

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This short note provides quantitative evaluation of our quadrangulation method tested on over 7.5K meshes from the Thingi10K database.

**Input surface meshes.** We tested on our approach on part of the triangle meshes provided in *Tetrahedral Meshing in the Wild*, which is based on Thingi10K. This represents a total of 7929 connected mesh models (some of the inputs have multiple components).

**Frame fields (direction and metric).** Frame fields were generated with [Jiang et al., 2015]. We set the average size of frame field (i.e. edge length of quad) to be 2% of the bounding box of the input model. All the frame fields are curl-corrected with [Zhang et al., 2010] with weights $w_z = 0.1, w_s = 1$ and $w_a = 0.1$ (representing size, smoothness and anisotropy respectively).

**Sharp features.** Any input edge with a dihedral angle smaller than $70^\circ$ is tagged as a sharp feature.

**Quality measurement.** We report the distribution of the average scaled Jacobian (see Fig. 3) and the minimum scaled Jacobian (see Fig. 5) for the test dataset. We also report the Hausdorff distance between input and output feature lines, see Fig. 6.

**Note about frame field.** Our automatic frame field generation canbe suboptimal for some models, see Fig. 3: depending on the shape of the models (in particular, if they have closed features), the size of the input frame fields should be chosen smaller, see the screw in Fig. 1 for instance.

**Note about quality.** As mentioned in our paper, the scaled Jacobian may be negative in a few spots; but it does not mean that there is not a one-to-one mapping between the quad element and a square, see Fig. 2. A simple local subdivision can make all quads having positive scaled Jacobian (see Fig. 5): for each quad with negative scaled Jacobian, we first split it into two triangles along the edge which maximizes the minimum angle of the two triangles, then subdivide the resulting hybrid mesh into quads by adding new vertices in the middle of edges and faces. The procedure is illustrated by the dashed lines in Fig. 2.

## References

[Jiang et al., 2015] Jiang, T., Fang, X., Huang, J., Bao, H., Tong, Y., and Desbrun, M. (2015). Frame field generation through metric customization. *ACM Trans. Graph.*, 34(4).

[Zhang et al., 2010] Zhang, M., Huang, J., Liu, X., and Bao, H. (2010). A wave-based anisotropic quadrangulation method. *ACM Trans. Graph.*, 29(4).

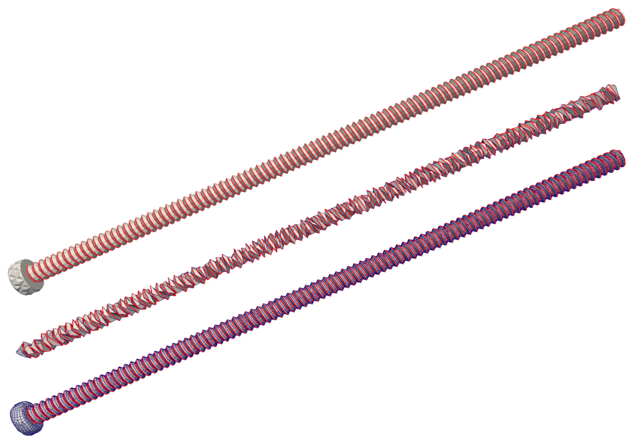

Figure 1: For the same input model (top), two different choices of size for the input frame fields: (middle) quad mesh result (average size of input field is 2.8, average S.J. is $-0.02$), (bottom) quad mesh result (average size of input frame field is 0.43, average S.J. is 0.95).

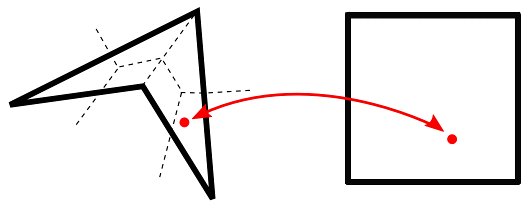

Figure 2: A one-to-one mapping exists between the left quad and the right square, even when the left one has a negative scaled Jacobian.

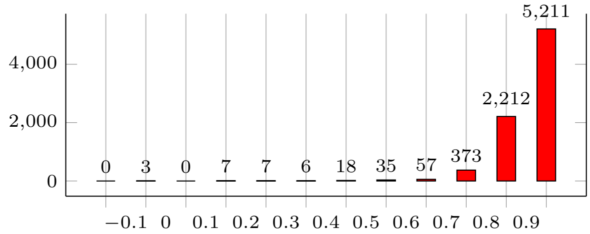


Figure 3: Distribution of average scaled Jacobian.

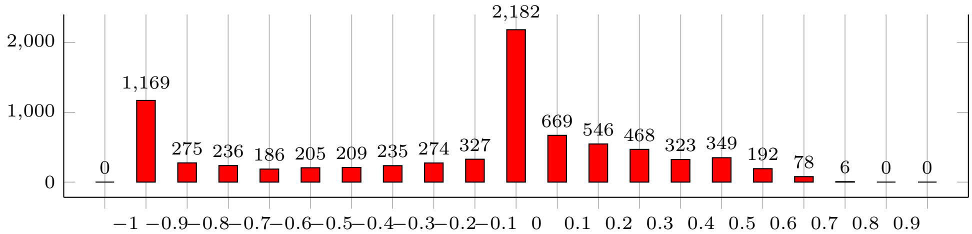


Figure 4: Distribution of minimum scaled Jacobian.

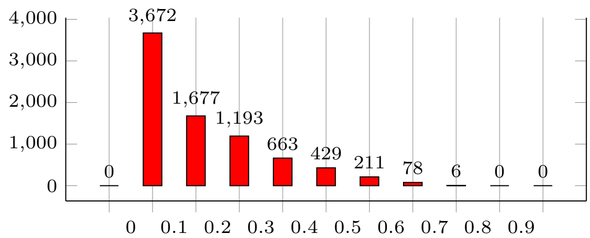


Figure 5: Distribution of minimum scaled Jacobian of subdivided meshes: subdivide the bad elements (SJ $\leq 0.01$) into two triangles, then subdivide all elements into quads globally.

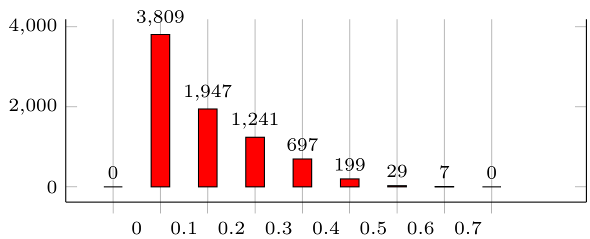


Figure 6: Distribution of Hausdorff distance between input and output features (%BBox).