MPDA'18 Algorithms

Algorithm 1 Parallel Transport Method

Input: A surface Φ, represented as a triangular mesh (V,E,F)

1: Place a geodesic curve g_x along S such that it divides the surface completely in 2.
2: Divide the curve into N equally spaced points p with distance W.
3: Place an vector $\mathbf{v}$ onto p_0
4: Parallel transport that vector along g_x as described in [@fig:parTransProc].
5: **for all** points p_i where i = 0,...,M **do**
6: Generate geodesic curve $+g_i$ and $-g_i$ using vector $\mathbf{v}_i$ and $-\mathbf{v}_i$ respectively.
7: Join $+g_i$ and $-g_i$ together to obtain g_i
8: Add g_i to output.
9: **end for**

Output: Set of geodesic curves $g_i, \quad where \quad i = 0, ..., M$

Algorithm 2 Evolution Method

Input: A surface Φ, represented as a triangular mesh (V,E,F), a desired width W, and a starting geodesic curve g_0.

1: Place a geodesic curve g_i along Φ and name it g_0.
2: Divide the curve into equally N number of sample points.
3: **for all** points $p_i \quad$ where $\quad i = 0, ..., N$ **do**
4: Find tangent vector $\mathbf{v}_i^T$ of g
5: Rotate $\mathbf{v}_i^T$ by $\frac{\pi}{4}$
6: Generate geodesic $h_i^{\perp}$ from p_i and $\mathbf{v}_g^T$
7: **end for**
8: Compute BEST FIT GEODESIC g_{i+1}
9: **if** No best fit is found **then**
10: BREAK
11: **end if**
12: Make g_{i+1} the current geodesic for next iteration.

Output: Set G of geodesic curves $g_i, \quad where \quad i = 0, ..., M$

Algorithm 3 Calculate the best-fit geodesic

Input: Curve g_i,perp geodesics $h^{\perp}$, desired width W and an angle threshold α.

1: Obtain a point p_i at distance W from the starting point of each $g_i^{\perp}$
2: Select any point p_i as the start point and name it p_0.
3: Select the tangent vector $\mathbf{v}_T$ of $g_i^{\perp}$ at p_0.
4: Rotate $\mathbf{v}_T$ 90º around the normal of Φ at p_0.
5: Generate an initial geodesic g_i.
6: Obtain error measure ϵ as the least squares difference between the desired distance W and the actual distance D
7: Find the geodesic that has the least error by rotating v_T by a small amount each step.

Output: The next geodesic curve that best fits W.

Algorithm 4 Calculate the best-fit piecewise geodesic

Start from: Step ?? of Algorithm 3.

1: Find the largest interval I of g_{i+1} that does not exceed ϵ by a given
2: **if** g_i satisfies the ϵ for all $h^{\perp}$'s **then**
3: BREAK
4: **end if**
5: Split g_i
6: Remove used $h^{\perp}$ from list.
7: Start Algorithm 3 again using the new $h^{\perp}$, and the start/end point of g_i

On end: Continue from Step ?? of Algorithm 3.

Algorithm 5 Panels: Modified Tangent-developable method

Input: The reference surface Ψ, represented as a mesh (V,E,F) and a geodesic pattern of curves $g_{0\ldots N}$

1: Compute the *tangent developable surfaces* Ψ_i for all surfaces $s_i \rightarrow i =$ even numbers
2: Delete all rulings where the angle enclose with the tangent α is smaller than a certain threshold (i.e. 20º).
3: **for all** Rulings **do**
4: Determine points $A_i(x)$ and $B_i(x)$ which are the closest to geodesics s_{i-1} and s_{i+1}. This serves for trimming the surface Ψ_i.
5: **end for**
6: Trim Ψ_i with the curve generated from all points $A_i(x)$ and $B_i(x)$ respectively.

Output: Trimmed developable surface Ψ_i.