A Geometric Strategy Algorithm for Orthogonal Projection onto a Parametric Surface

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Description of Geometric Strategy Algorithm (GSA)

- **Input:** the initial parametric value $\mathbf{t}_0 = (u_0, v_0)^T$, parametric surface **s**(u,v) and test point **p**.
- **Output:** the final orthogonal projection point $\mathbf{p}_\Gamma$. p_Γ
- **Procedures**

-- **Step 1**. Input the initial iterative parametric value t_0 .

$\|\Delta \mathbf{t}\| < \varepsilon$

Description of Geometric Strategy Algorithm (GSA)

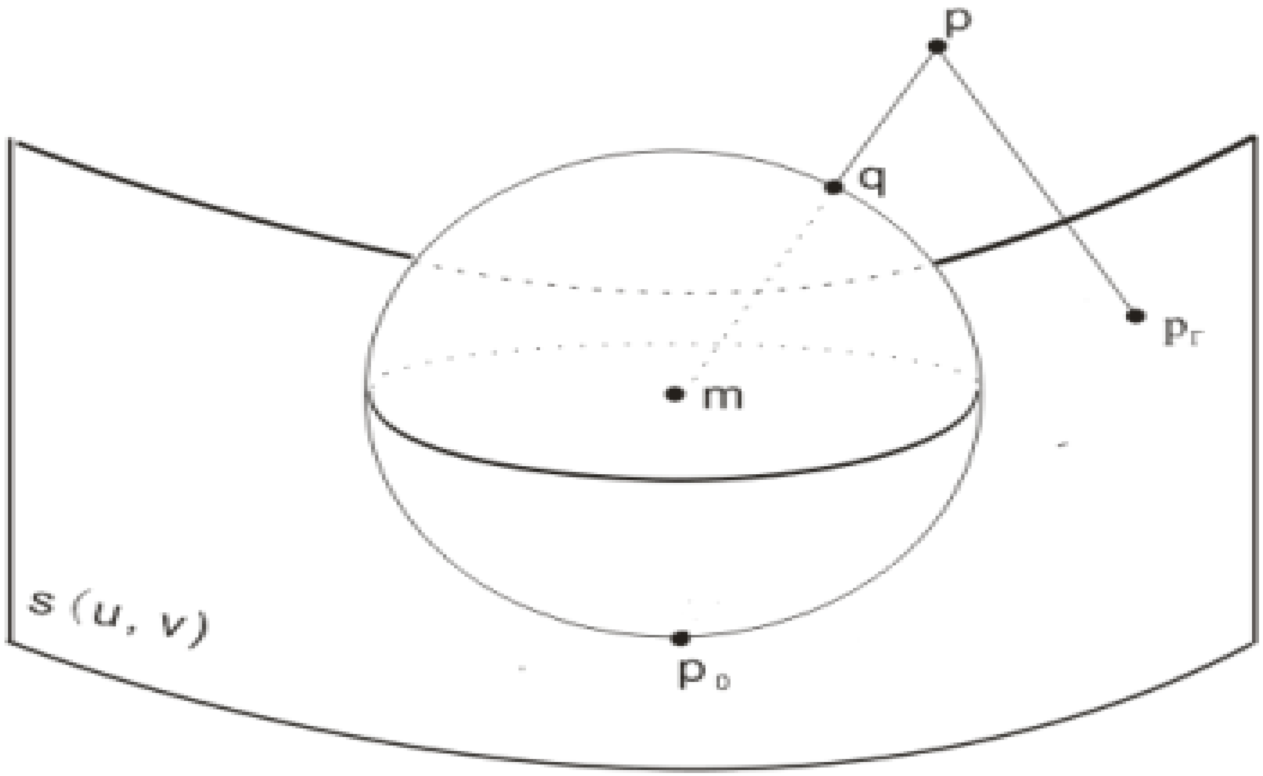
-- Step 2. Use the iterative Formula (20), compute the parametric incremental value $\Delta t = (\Delta u, \Delta v)T$, and update $t_0 + \Delta t$ to t_0 , namely, $t_0 = t_0 + \Delta t$.

-- Step 3. Check whether the norm of difference between the former t_0 and the latter t_0 is near 0 $(\|\Delta \mathbf{t}\| < \varepsilon)$ .If so, end this algorithm, if not, go to **Step 2.**

The Iterative Formula (20) of the GSA

$$\begin{cases} \Delta u = \dfrac{C_4 G - C_5 F}{EG - F^2}, \\ \Delta v = -\dfrac{C_4 F - C_5 E}{EG - F^2}. \end{cases}$$

Graphic demonstration for the GSA



The Superiority of the GSA over Existing Methods

- Firstly, the GSA converges faster than existing methods, such as the method to turn the problem into a root-finding of nonlinear system, subdividing methods, clipping methods, geometric methods (tangent vector and geometric curvature) and hybrid second order method, etc. Specially, it converges faster than the classical Newton's iterative method.
- Secondly, the **GSA** is independent of the initial iterative value, which we prove in Theorem 1.