# Computer Graphics and Multimedia

## Tutorial 4 : Surface Patches

1. A single Hermite segment is a cubic polynomial as discussed during the lecture. Bicubic Hermite Patch is an extension of Hermite curve segment and we call it a bicubic surface patch. The product of two curves notation leads to the following compact representation of the Hermite surface patch.

$$P(u,w) = [u^3\ u^2\ u\ 1]H \begin{bmatrix} P_{00} & P_{01} & P^w_{00} & P^w_{01} \\ P_{10} & P_{11} & P^w_{10} & P^w_{11} \\ P^u_{00} & P^u_{01} & P^{uw}_{00} & P^{uw}_{01} \\ P^u_{10} & P^u_{11} & P^{uw}_{10} & P^{uw}_{11} \end{bmatrix} H^T \begin{bmatrix} w^3 \\ w^2 \\ w \\ 1 \end{bmatrix}, \tag{1}$$

   where $P^{uw}_{i,j}$ is partial derivative of the surface patch $\frac{\partial^2 P}{\partial u \partial w}$ at $(i,j)$. These quantities are useful when joining two Hermite patches. For a single patch, the values of the same are set to zero.

   We have been talking about barycentric representation and also kept claiming that the shape of the object remains undisturbed (invariant) under the coordinate transformations.

   Show that the surface $P(u,w)$ preserves its shape with the help of an example.

2. Write a function called `myExpM` that takes in an arbitrary axis of rotation $w \in \mathbb{R}^3$ along with an angle $\theta$, and outputs the corresponding rotation matrix $R_w(\theta) \in SO(3)$. [Hint: Rodrigue's formula.]

3. Write a function called `myLogM` that takes in an arbitrary rotation $R \in SO(3)$ and outputs the corresponding rotation axis $w \in \mathbb{R}^3$ and the angle $\theta$.

4. In Blender look for add tab. Explore curve, mesh and surface. Play around with the objects that you create. Try to correlate with the Bezier and Hermite curves that we have looked at in the class.