TECHNIQUES AVAILABLE FOR SURFACE MODELING

- Surface patch
- Coons patch
- Bicubic patch
- Hermite surfaces
- Bezier surfaces
- B-spline surfaces

SURFACE PATCH

- A surface patch is defined in terms of point data will usually be based on a rectangular array data points.
- In computer graphics, the parametric surface are sometimes called *patches, curved surfaces or* just *surface.*
- The building blocks of the surfaces are known as surface patch
- Generally u and v are two variables used for representing a patch.

$$P(u,v) = [x \quad y \quad z]^T = [x(u,v) \quad y(u,v) \quad z(u,v)]^T$$

$$u_{min} \leq u \leq u_{max} and\ v_{min} \leq v \leq v_{max}$$

Cont...,

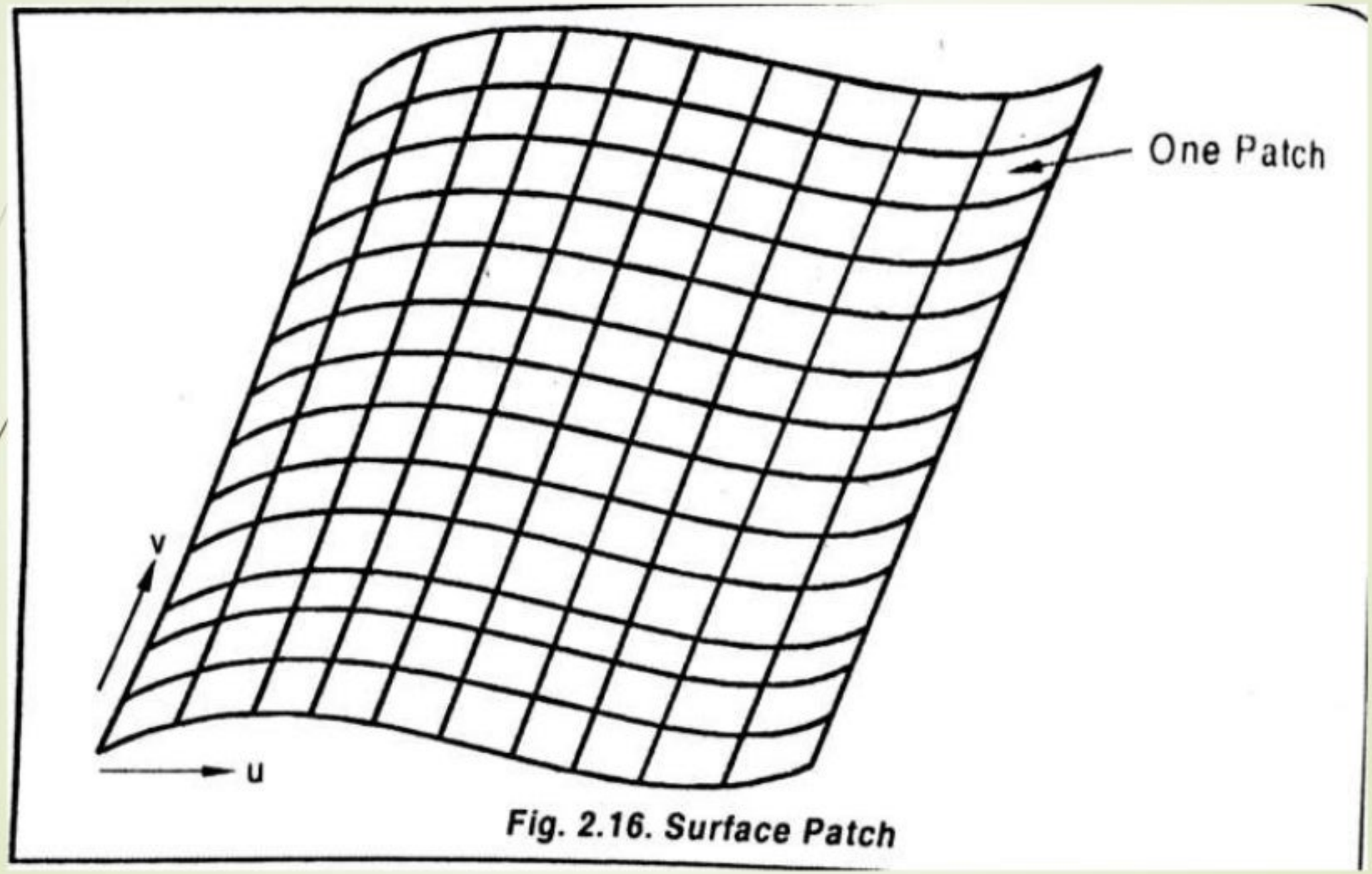


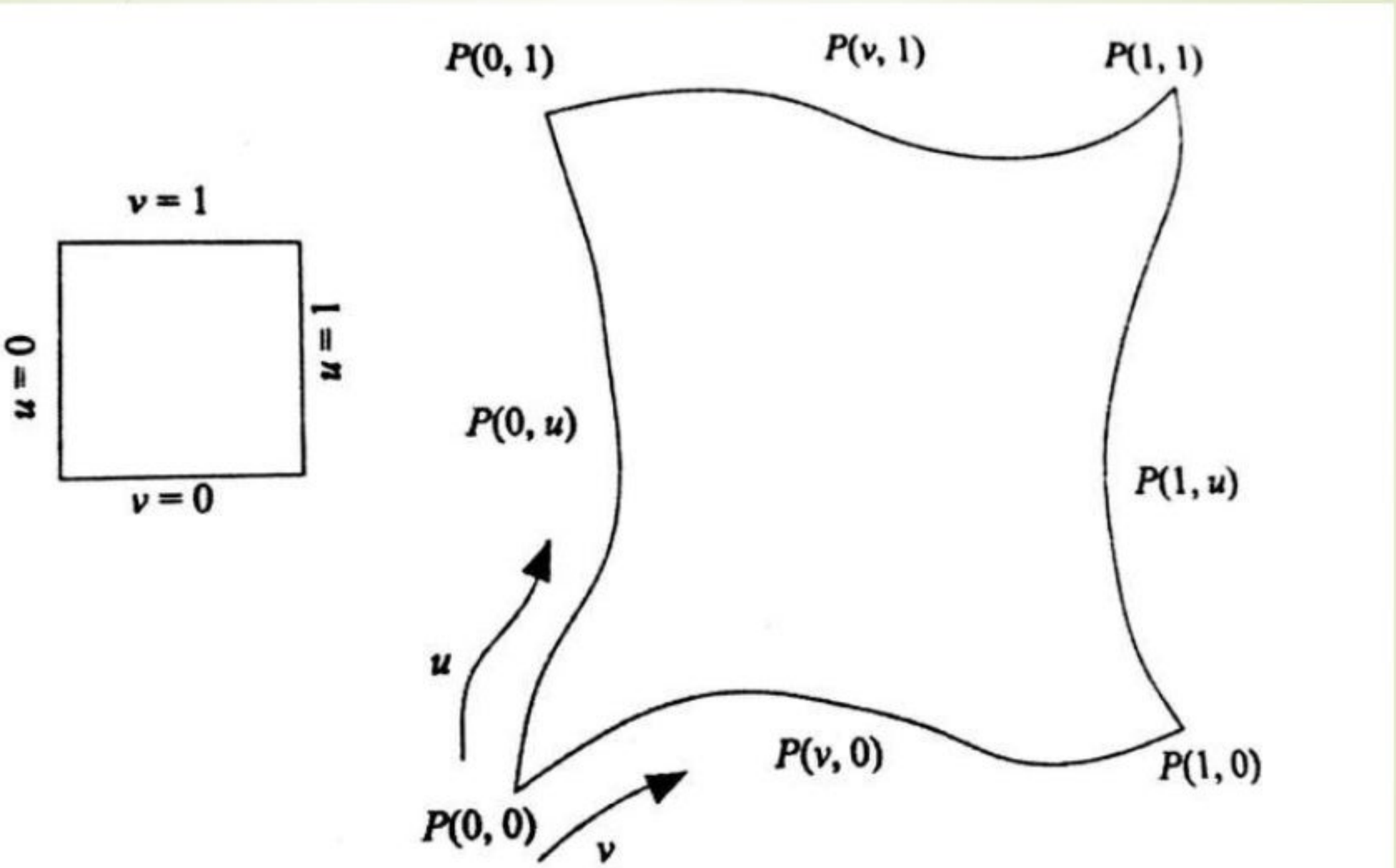
Fig. 2.16. Surface Patch

COONS PATCH

- A linear interpolation between four bounded curve is used to generate a *coons surface*, which is also called *coons patch*.
- The coons formulations interpolate to an infinite number of control points to generate the surface and it is referred as a form of transfinite interpolation.

$$P(u,v) = \{P(u,0)(1-v) + P(u,1)v\} + \{P(0,v)(1-u) + P(1,v)u\}$$

Cont...,



BICUBIC SURFACE

- Bicubic patch or surface is generated by four boundary curves which are parametric Bicubic polynomials.
- Bicubic parametric patches are defined over rectangular domain in *uv*-space and the boundary curves of patch are themselves cubic polynomial curves.
- The following are the major types of parametric bi-cubic surfaces used in CAD
  - Hermite surface
  - Bezier surface
  - B-Spline surface

HERMITE SURFACE

BEZIER SURFACE

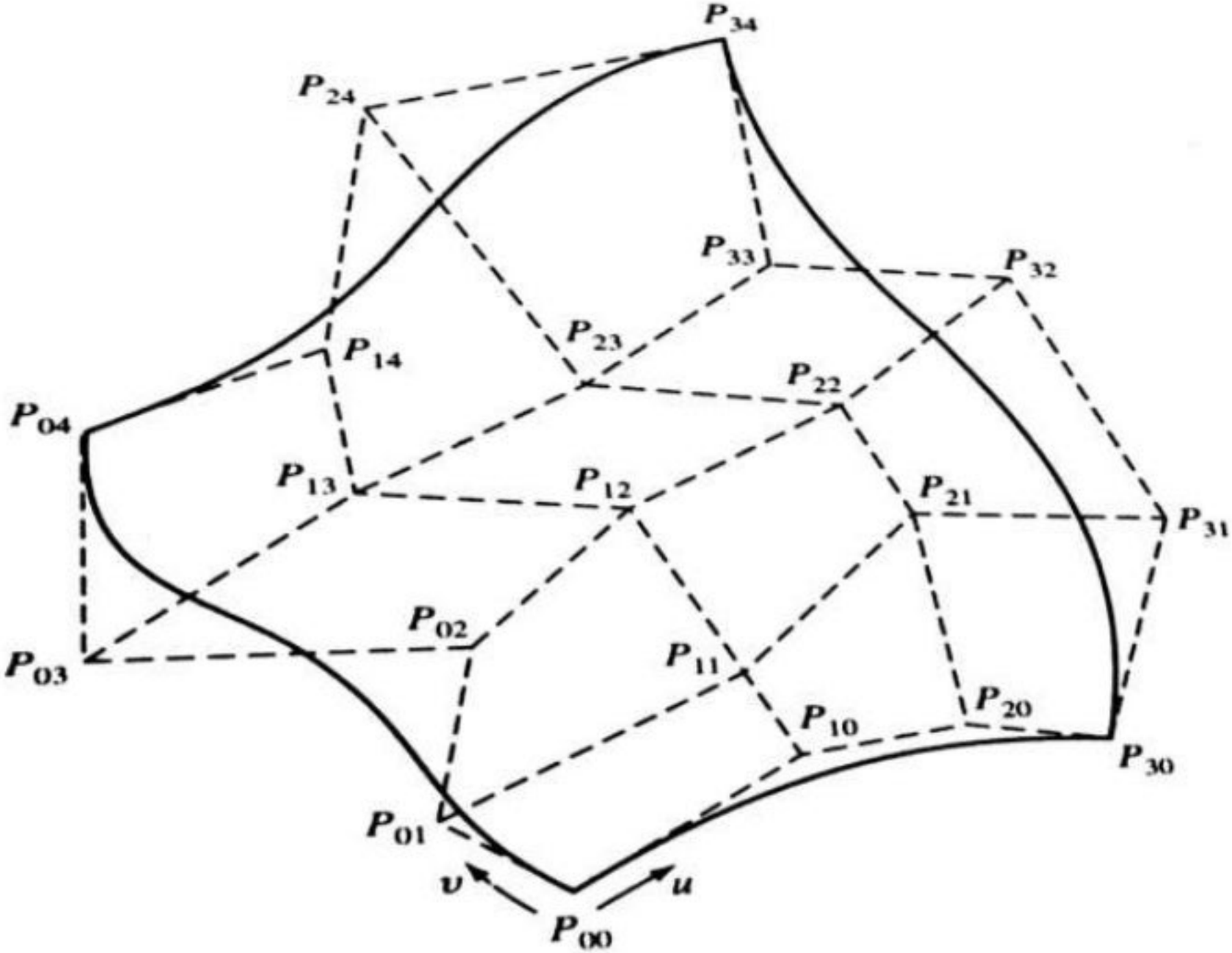
- Bezier surface is an extension of the Bezier curve in two parametric directions *u* and *v*.
- An orderly set of data or control points is used to build a topologically rectangular surface as shown in figure.

The surface equation can be written as

$$P(u,v) = \sum_{i=0}^{n}\sum_{j=0}^{m} P_{ij} B_{i,n}(u) B_{j,m}(v), \qquad 0 \le u \le 1, \qquad 0 \le v \le 1$$

where, P(u,v) is any point on the surface

P_{ij} are the control points


P_{34}
P_{24}
P_{33}
P_{32}
P_{14}
P_{23}
P_{22}
P_{04}
P_{13}
P_{12}
P_{21}
P_{31}
P_{02}
P_{11}
P_{20}
P_{03}
P_{10}
P_{30}
P_{01}
v
u
P_{00}

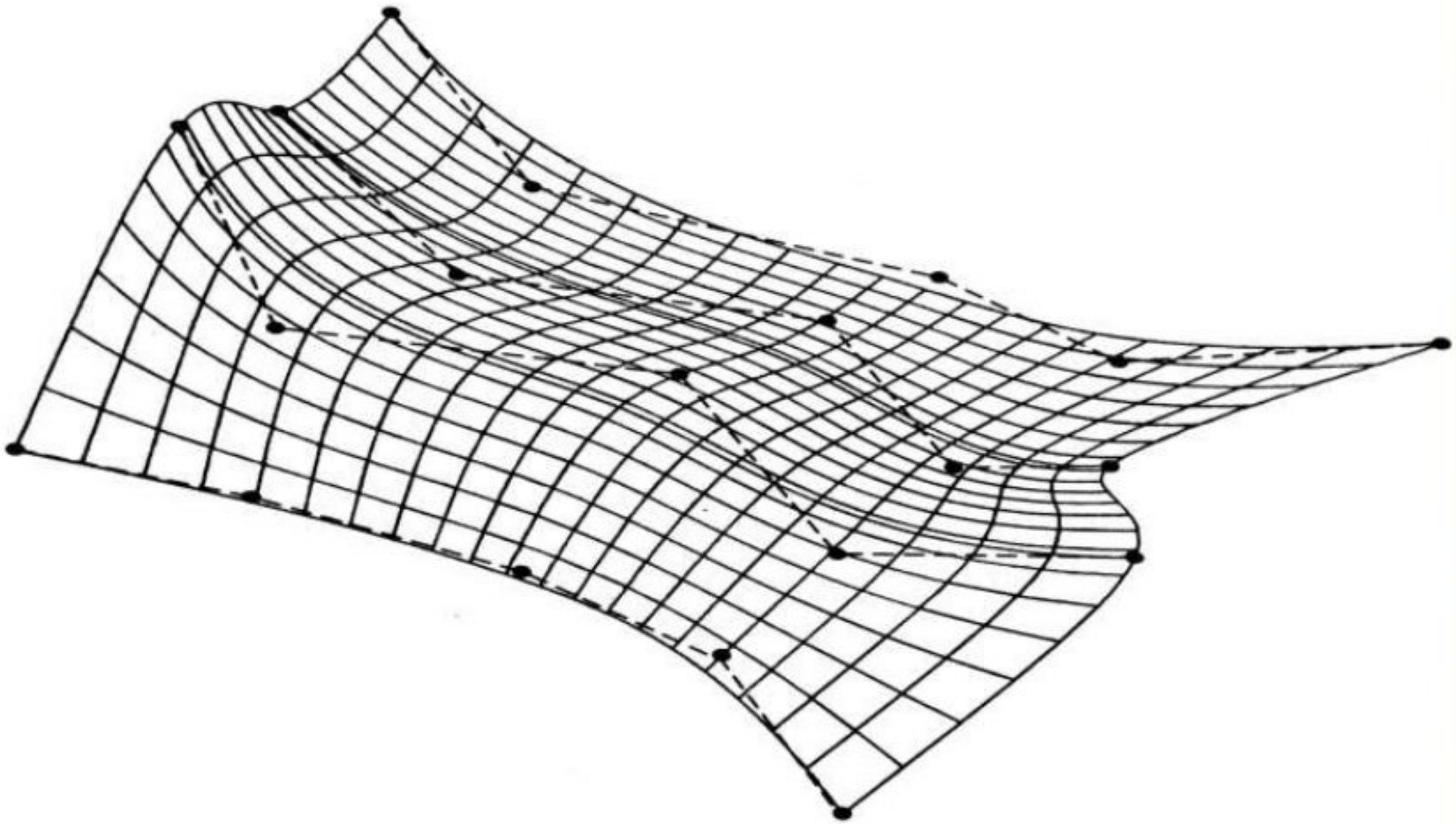
B-SPLINE SURFACE

- B-Spline surface is an extension of the B - Spline curve. A rectangle set of data points creates the surface.
- A B-Spline surface can approximate or interpolate the vertices of the polyhedron as shown in figure.
- B-Spline surface equation is defined by

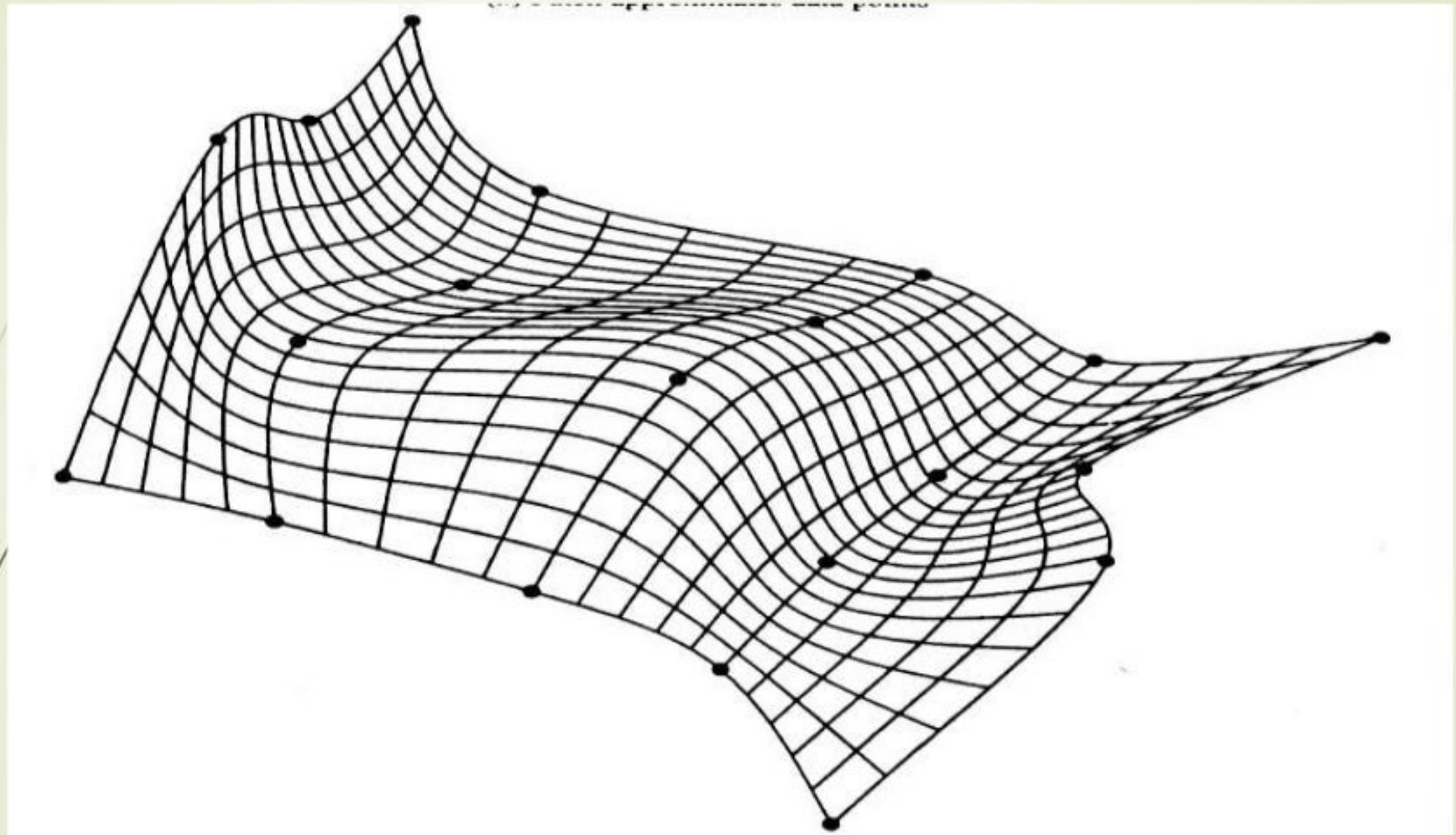
$$P(u,v) = \sum_{i=0}^{n}\sum_{j=0}^{m} P_{ij}\, B_{i,k}(u)\, B_{j,l}(v), \qquad 0 \le u \le 1, 0 \le v \le 1$$

where,P(u,v) is any point on the surface

P_{ij} are the control points



(*a*) Patch approximates data points



(*b*) Patch interpolates data points