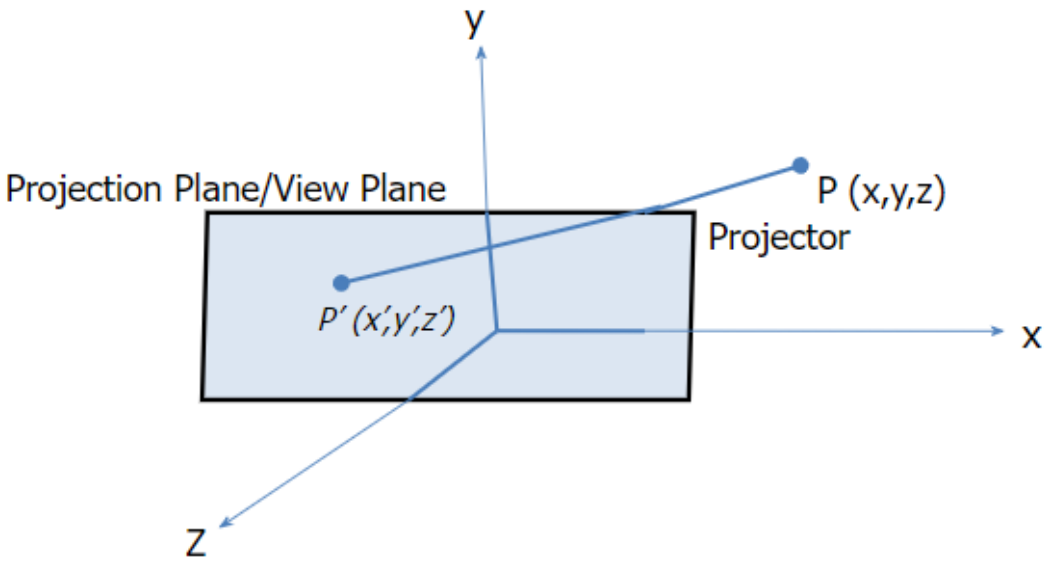
Computer Graphics

Projection

Md. Biplob Hosen
Assistant Professor, IIT-JU
Email: biplob.hosen@juniv.edu

Projection

- Projection is a technique or process which is used to transform a 3D object into a 2D plane.
- In other words, we can define “projection as a mapping of points P (x,y, z) on to its image P’ (x,’ y,’ z’) in the projection plane or view plane, which create the display surface”.
- The mapping is determined by a projection line called the projector that passes through P and intersects the view plane.
- The intersection point is P’.



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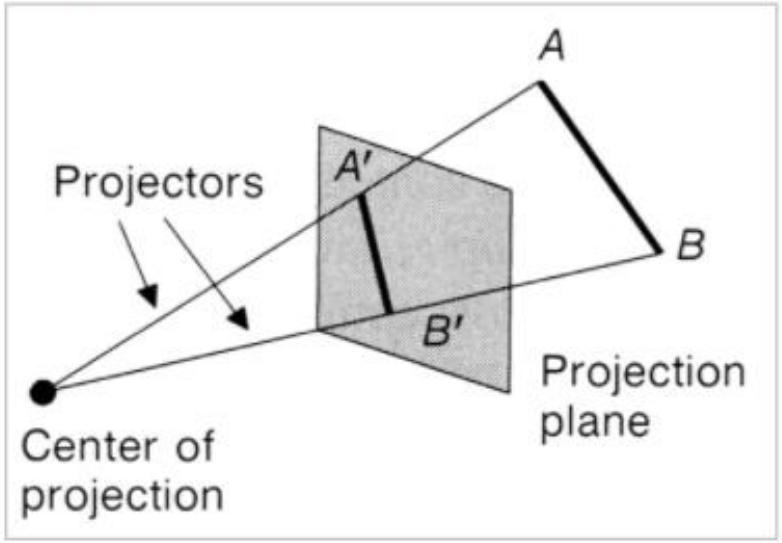
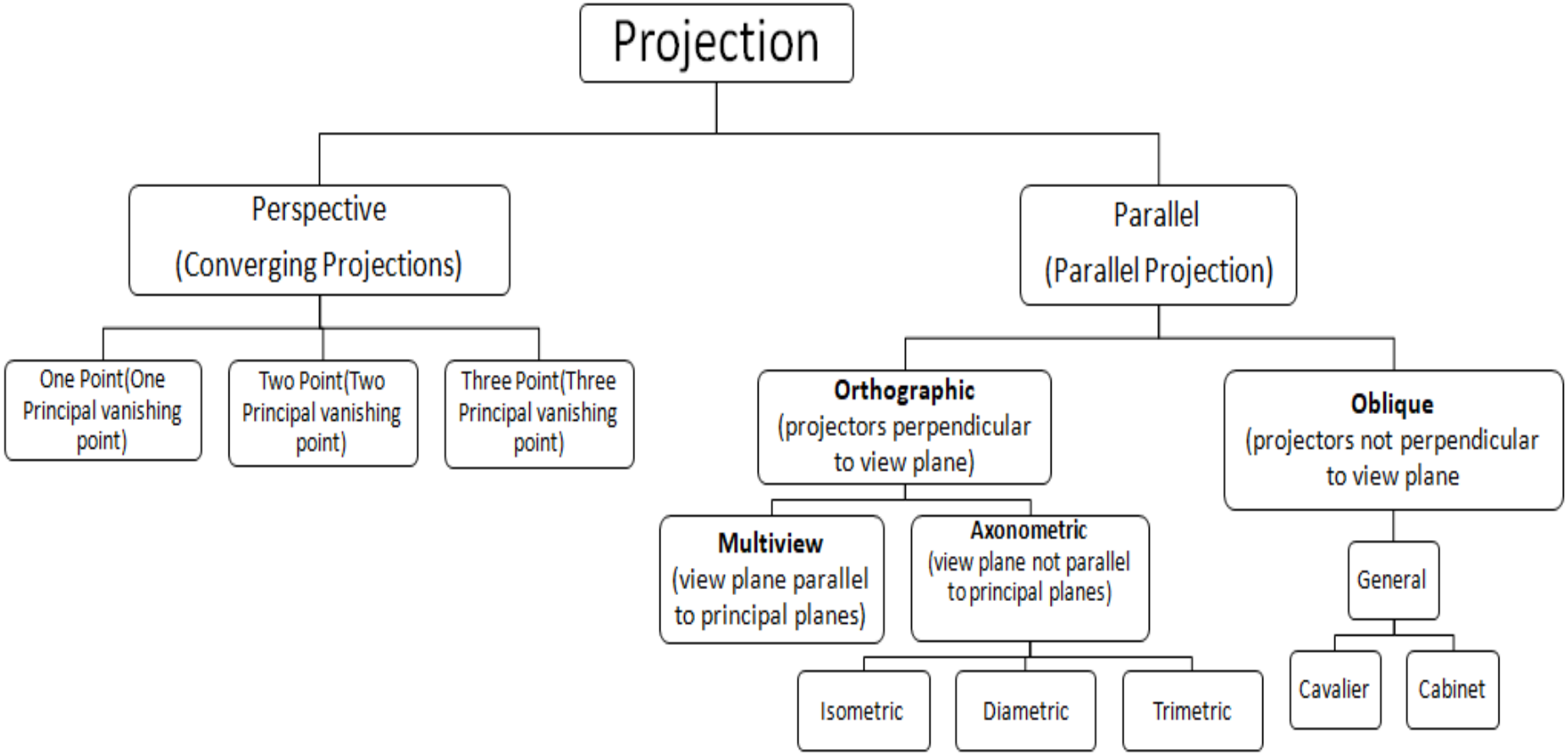
- Projection from 3D to 2D is defined by straight projection rays (projectors) emanating from the 'center of projection', passing through each point of the object, and intersecting the 'projection plane or view plane' to form a projection.
- Display device (a screen) is 2D.

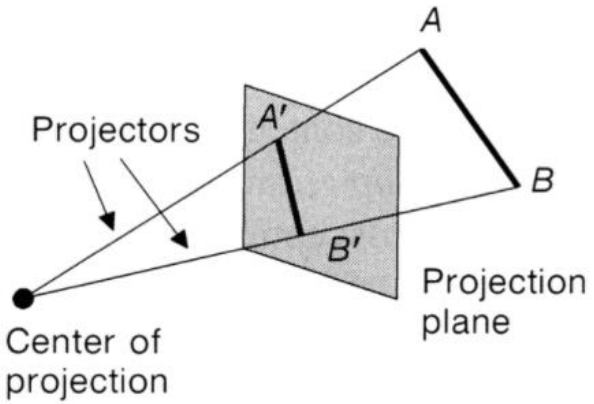


Taxonomy of Projection



Perspective Projection

- If distance to center of projection is finite:
  - perspective projection.
- Projection lines are crossing the view plane and converge in a projection reference point (PRP).
- An image point is determined by a projector that goes from an object point to the center of projection.
- Visual effect is similar to human visual system-
  - Has 'perspective foreshortening‘.
  - Size of object varies inversely with distance from the center of projection.
  - Angles only remain intact for faces parallel to projection plane.



Perspective Projection

- In perspective projection, farther away object from the viewer, small it appears.
- This property of projection gives an idea about depth.
- Two main characteristics of perspective are vanishing points and perspective foreshortening.
- Due to foreshortening object and lengths appear smaller from the center of projection.
- More we increase the distance from the center of projection, smaller will be the object appear.

Application of Perspective Projection:

- The perspective projection technique is used by artists in preparing drawings of three-dimensional objects and scenes.

Terms Related to Perspective Projection

- **View plane:** It is an area of world coordinate system which is projected into viewing plane.
- **Center of Projection:** It is the location of the eye on which projected light rays converge.
- **Projectors:** It is also called a projection vector. These are rays start from the object scene and are used to create an image of the object on viewing or view plane.

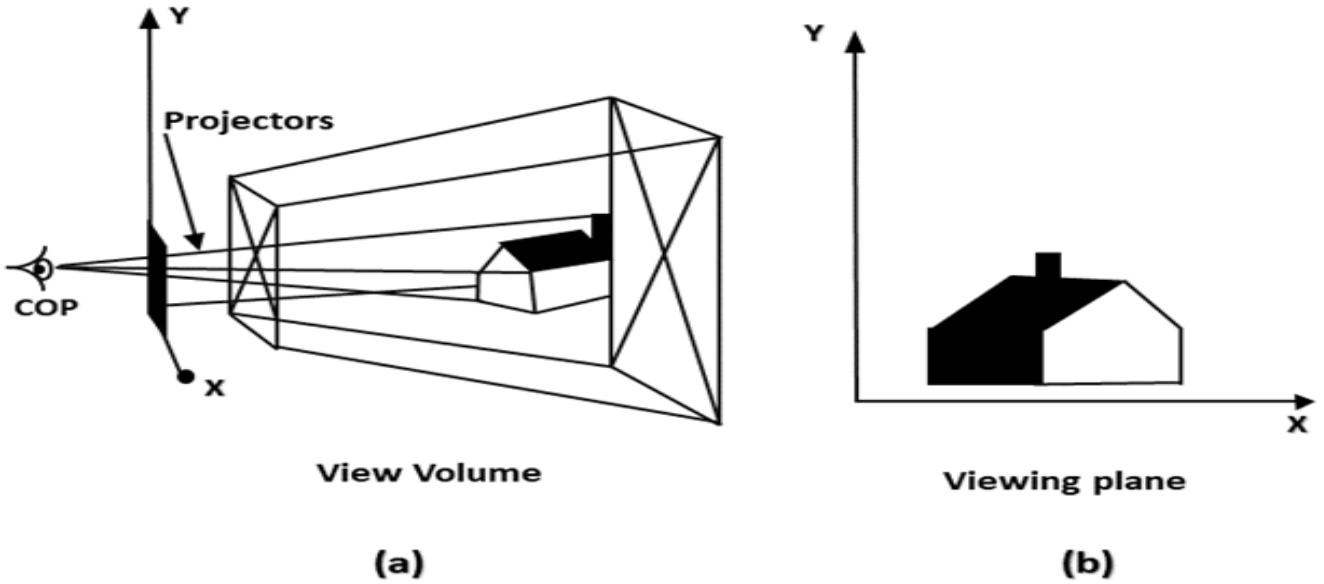


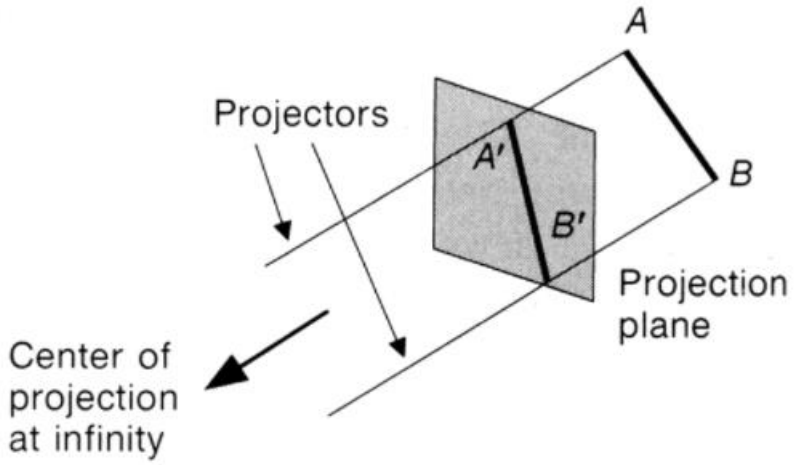
Fig: Prespective Projection

Categories of Perspective Projection

- **Vanishing Point**:
  - It is the point where all lines will appear to meet. There can be one point, two point, and three point perspectives.
- **One Point:** There is only one vanishing point.
- **Two Points:** There are two vanishing points. One is the x-direction and other in the y –direction.
- **Three Points:** There are three vanishing points. One is x second in y and third in two directions.

Parallel Projection

- Parallel projection
  - All projection lines are crossing the view plane in parallel; preserve relative proportions.
  - Less realistic view because of no foreshortening.
  - Parallel lines remain parallel.
  - Angles only remain intact for faces parallel to projection plane.



Parallel Projection

- Parallel projection displays picture in its true shape and size.
- When projectors are perpendicular to view plane, then it is called **orthographic** projection. Otherwise, it is **oblique**.
- The parallel projection is formed by extending parallel lines from each vertex on the object until they intersect the plane of the screen. The point of intersection is the projection of vertex.

Application of Perspective Projection:

- The perspective projection technique is used by drafters and engineers to create working drawings of an object which preserves its scale and shape.

Perspective vs. Parallel

- **Perspective projection:**

- Size varies inversely with distance - looks realistic.

- Distance and angles are not (in general) preserved.

- Parallel lines do not remain parallel.

- **Parallel projection**

- Good for exact measurements.

- Parallel lines remain parallel.

- Angles are not (in general) preserved.

- Less realistic looking.

Thank You ☺