2. Detecting Symmetries Reflection Symmetry Detection

Technique: Symmetry Detection using PCA (Principal Component Analysis)

Docs: https://docs.opencv.org/4.x/d1/dee/tutorial introduction to pca.html (ML based)

Pytorch symmetry detection

Paper: https://cvlab.postech.ac.kr/research/EquiSym/ Github

: <https://cvlab.postech.ac.kr/research/EquiSym/>

**2. Exploring Symmetry in Curves**

**Objective**: To identify the presence of symmetry in closed shapes. Symmetry can be reflectional (mirror symmetry).

**Types of Reflection Symmetry**:

* **Vertical Symmetry**
* **Horizontal Symmetry**
* **Diagonal Symmetry**

**Approach**:

1. **Data Input**: Use polylines or closed curves as input.
2. **Symmetry Detection**: Implement algorithms to check for lines of symmetry by analyzing the coordinates of the points. For reflection symmetry, check if points on one side of a line match points on the other side.
3. **Identical Looking Curves**:
   1. The statement begins by noting that two curves can appear identical to the eye but may be constructed using different sequences of Bézier curves. Bézier curves are mathematical curves that are defined by control points, and different sets of control points can produce curves that look the same visually.
4. **Identifying Symmetry**:
   1. The task involves identifying symmetry in these curves. Symmetry in this context refers to the property where a shape can be divided into two parts that are mirror images of each other. For example, a butterfly shape has bilateral symmetry.
5. **Transforming Presentation to Points**:
   1. To analyze symmetry effectively, it is suggested to transform the curve representation into a set of points. This means taking the curve and sampling it at various points along its length, which allows for a more straightforward analysis of its geometric properties.
6. **First Stage of Symmetry Identification**:
   1. In the initial phase, the focus is on identifying the symmetry of the curve based on the set of points derived from it. This could involve checking for reflectional symmetry (where one half mirrors the other) or rotational symmetry (where the shape looks the same after a certain rotation).
7. **Fitting Identical Bézier Curves**:
   1. Once symmetry is identified, the next step is to fit Bézier curves to the points that exhibit symmetry. This means creating a new Bézier curve (or curves) that accurately represent the symmetric points, ensuring that the resulting curves maintain the identified symmetrical properties.
8. **Output**: A report detailing the types of symmetry found in each shape, including the lines of symmetry.

**Example**:

* **Input**: A closed polyline representing a butterfly shape.
* **Output**: Identification of reflection symmetry along the vertical axis, with details about the symmetry line.