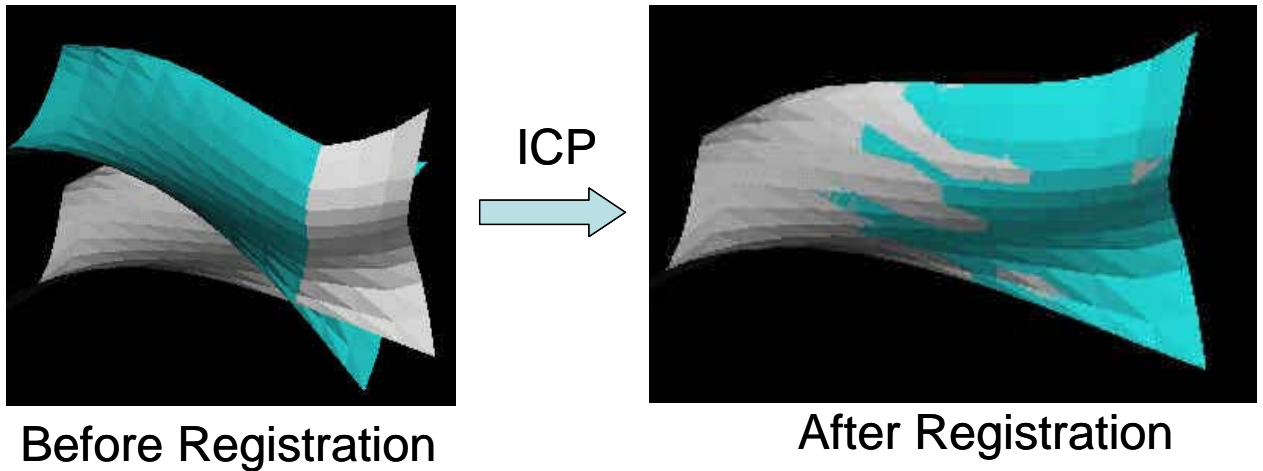


3D REGISTRATION



Mathematically speaking, registration of two 3D objects refers to finding the best 3D transformation based on minimum error between matching data points. One of the well-known algorithms for this purpose is the Interactive Closest Point (ICP) algorithm. The alignment of two 3D objects can be achieved in three consecutive steps using ICP algorithm:

```
repeat  
    identify corresponding points of range pairs  
    compute optimal transformation  
    error = compute distance between range pairs  
    num_iterations++;  
    if (num_iterations > iteration_threshold) break  
until error < error_threshold
```

First, corresponding points in two 3D objects are identified. You can use point to point correspondences (i.e. finding the pairs of closest points). One can also compute the correspondences by computing the closest surface points, also known as point-plane correspondence. While the “point-plane” approach is more robust, it is computationally more expensive than “point-point” approach. Following the computation of matching points, an optimum rigid transformation that reduces the distance between the two sets of corresponding points is calculated. Hence, for the given two sets of points, the problem is to find a rotation matrix and translation vector that minimize the distance error in least square sense. The solution is iterated until a pre-defined convergence criterion is satisfied.

References:

1. Besl and McKay, 1992, “A method for registration of 3d shapes”, IEEE Transactions on Pattern Analysis and Machine Intelligence, 14(2):239-256.