CS 763: Course Project Report

Topic: Point set registration using iterative closest point (ICP) and robust point matching (RPM)

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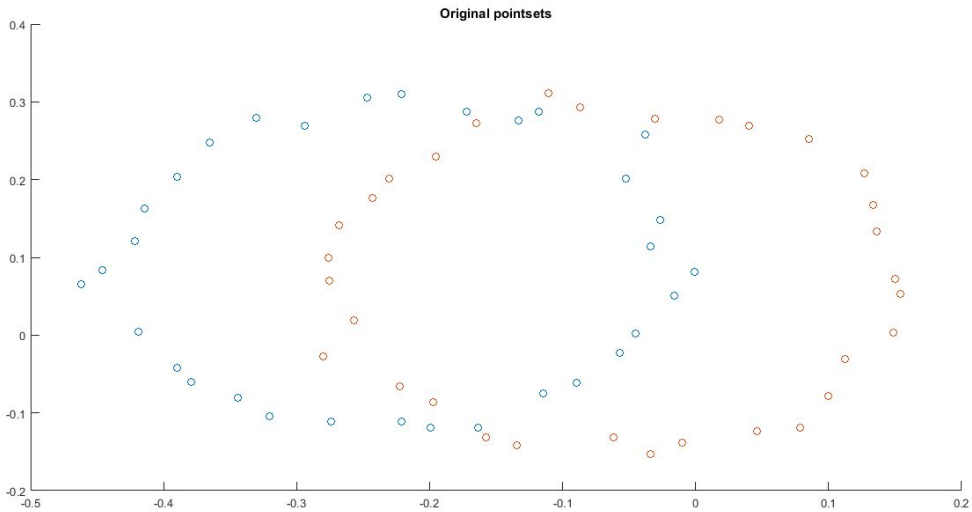
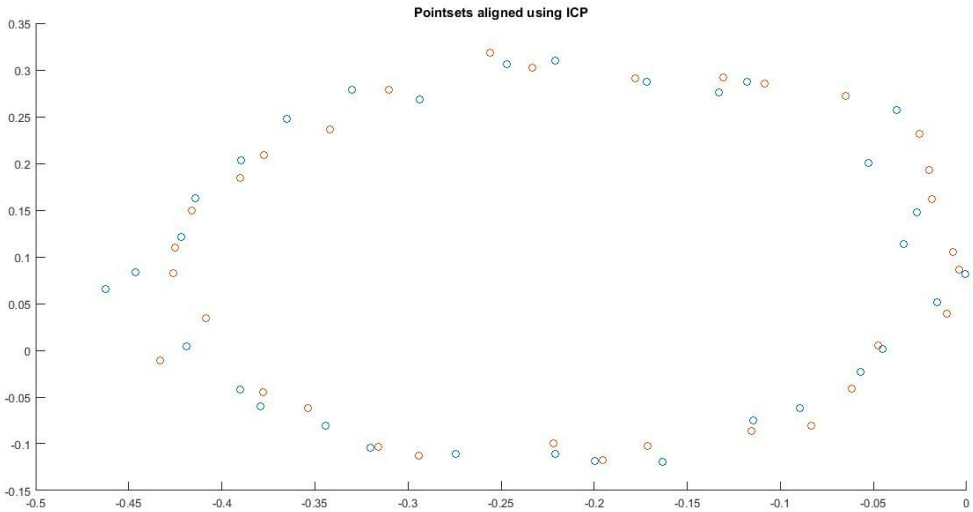
Implementations:

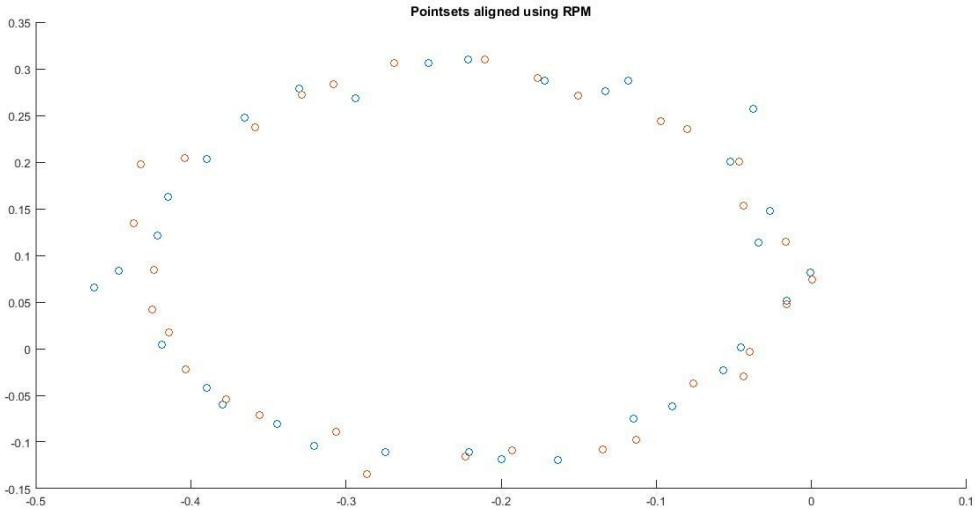
- Automated detection techniques(fast marching, grab-cut, Active-contours)
  - Some code has been adapted
- Smoothing of the mask boundary by using a signed distance transform
- Surprisal of the boundary curve (adapted)
- ICP, RPM point matching algos
- Kernel Correlation (buggy code)

Results on ellipse pointsets

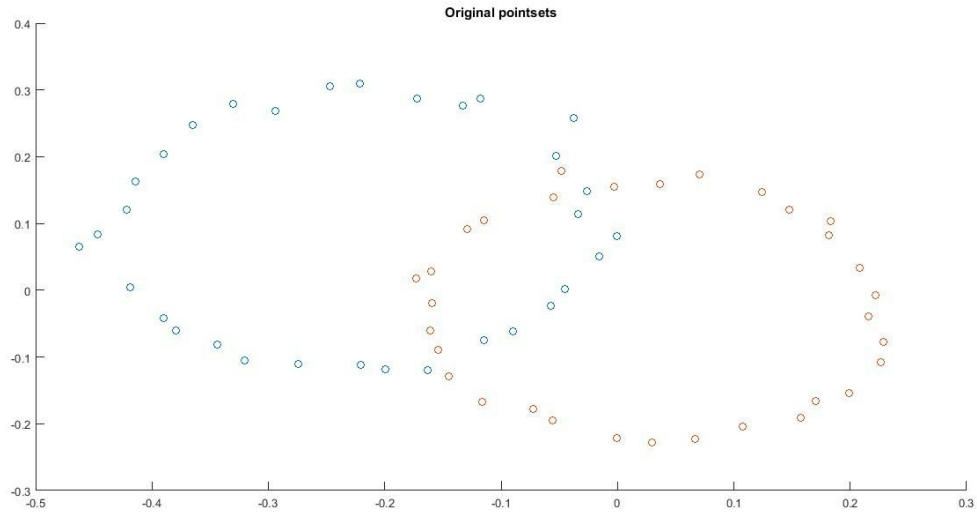
1. For small pose variation

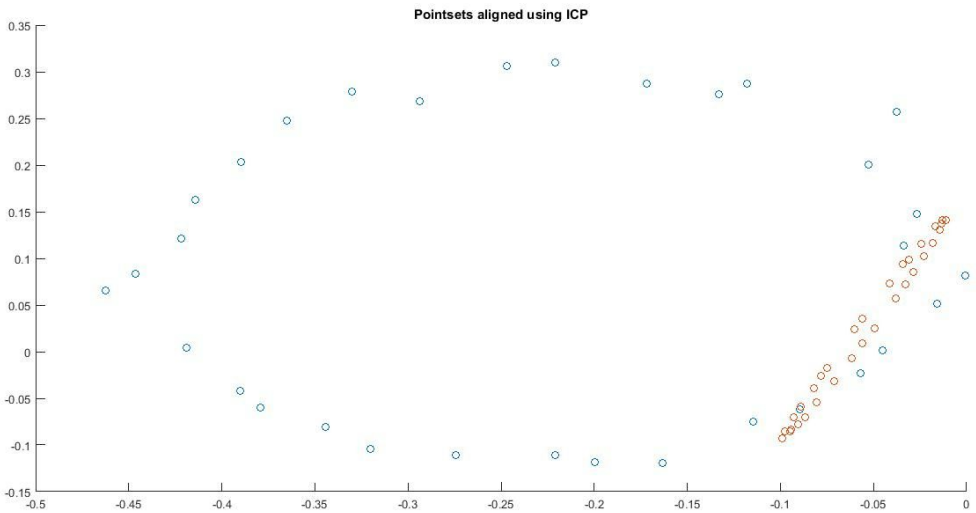


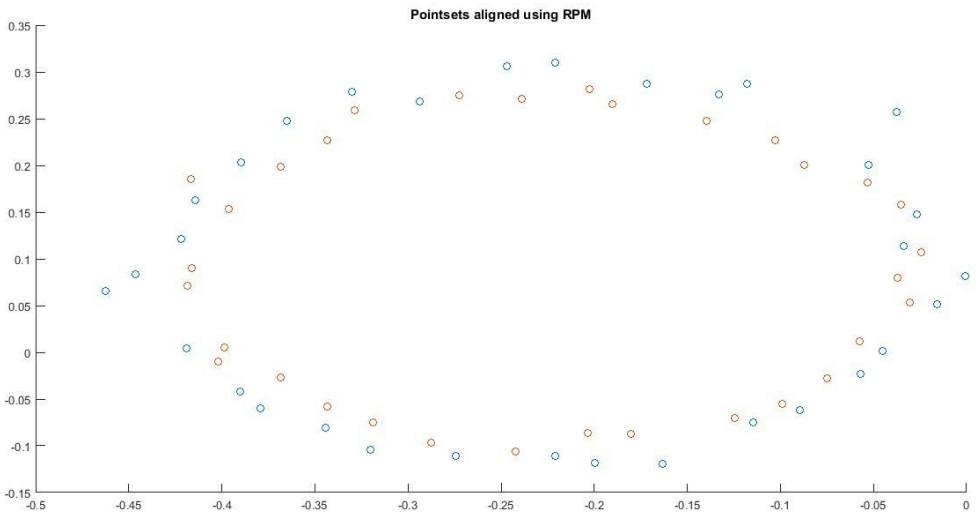




2. For large pose variation


Original pointsets
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3

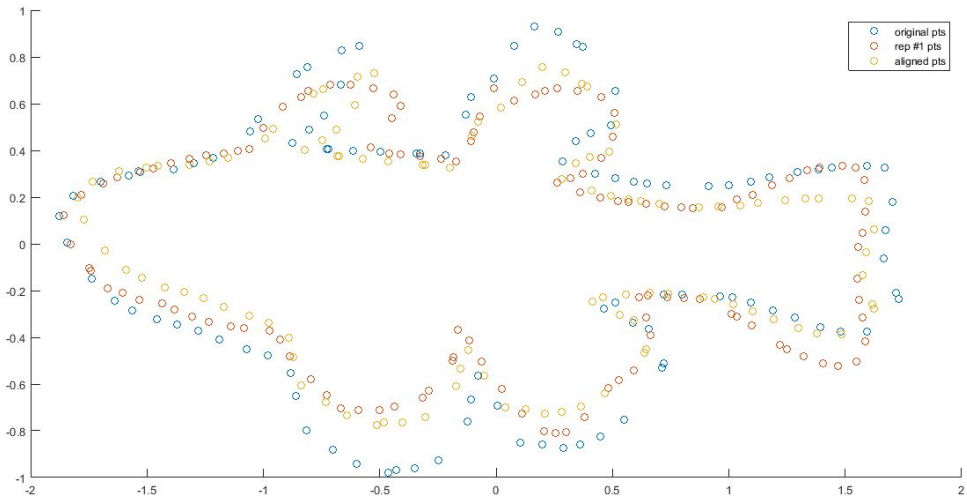

Pointsets aligned using ICP
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.5
-0.45
-0.4
-0.35
-0.3
-0.25
-0.2
-0.15
-0.1
-0.05
0


Pointsets aligned using RPM
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.5
-0.45
-0.4
-0.35
-0.3
-0.25
-0.2
-0.15
-0.1
-0.05
0

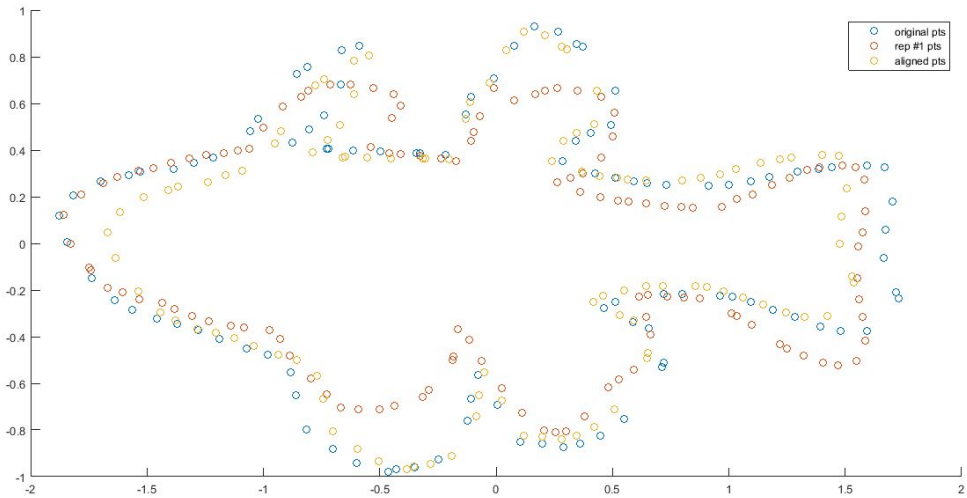
Results on fish pointsets

We brought each point set in preshape space as ICP gets stuck in a local minimum if the variation in the initial pose is large and RPM penalises large values of scaling and shear parameters.

1. Using ICP



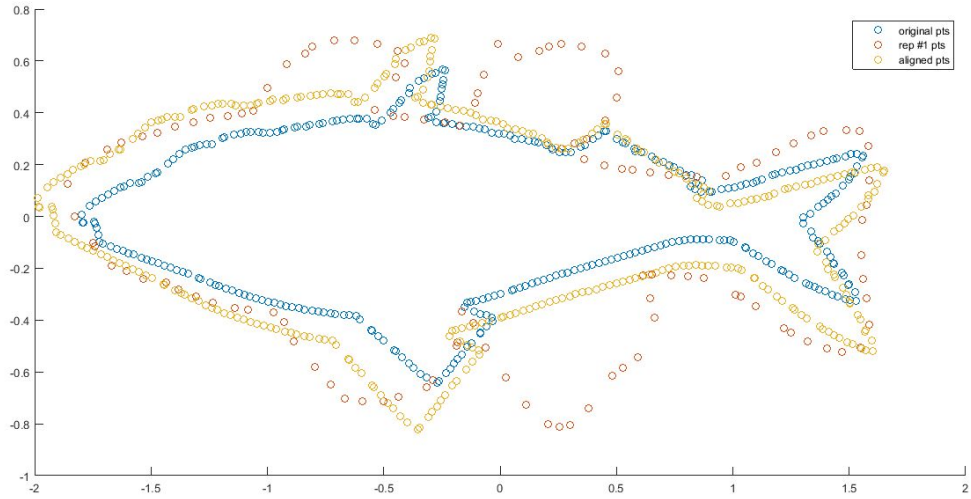
2. Using RPM



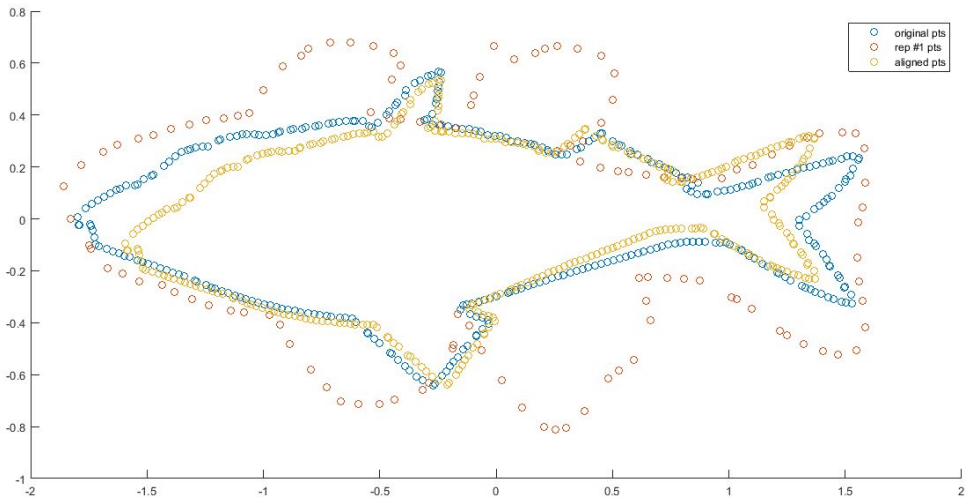
We can see that ICP aligns the pointsets along the ‘flat’ portions of the fish whereas RPM aligns them along the fins. This is because ICP gets stuck in a local minimum (as the flat portions are well aligned initially) whereas RPM finds the global optimum.

We also tried to align one species with another:

1. Using ICP



2. Using RPM



We can see that in case of alignment between two different species, the fins are not aligned. Hence, this framework can also be used for recognition of fish using these registration algorithms.

References

1. Besl, Paul J., and Neil D. McKay. "Method for registration of 3-D shapes."*Robotics-DL tentative*. International Society for Optics and Photonics, 1992.
2. Gold, Steven et al. "New algorithms for 2D and 3D point matching: Pose estimation and correspondence." *Pattern recognition* 31.8 (1998): 1019-1031.
3. Feldman, Jacob, and Manish Singh. "Information along contours and object boundaries." *Psychological review* 112.1 (2005): 243.

4. Rother, Carsten, Vladimir Kolmogorov, and Andrew Blake. "Grabcut: Interactive foreground extraction using iterated graph cuts." *ACM transactions on graphics (TOG)* 8 Aug. 2004: 309-314.
5. Chan, Tony F, and Luminita A Vese. "Active contours without edges." *Image processing, IEEE transactions on* 10.2 (2001): 266-277.