

Axially Symmetric 3D Pots Configuration System using Axis of Symmetry and Break Curve (Supplementary material)

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Abstract

This supplementary material presents details of the experiments addressed in the main paper. Results for individual steps of the pot configuration pipeline are illustrated for real and synthetic datasets. Four experiments show the reassembly of a computer generated axially symmetric pot from 10, 17, 23 and 30 unorganized broken pieces, respectively. Gaussian noise was added to make the problem realistic. The last experiment shows the reassembly of three real pots from a single pile of 48 mixed and unorganized real fragments (including many sherds found in archaeological site). The system has no a priori information about the pile of fragments. The number of pots in a pile, the number of fragments per pot and the number of missing pieces are all unknown.

1. Experiments with synthetic data (data1, 10 fragments)

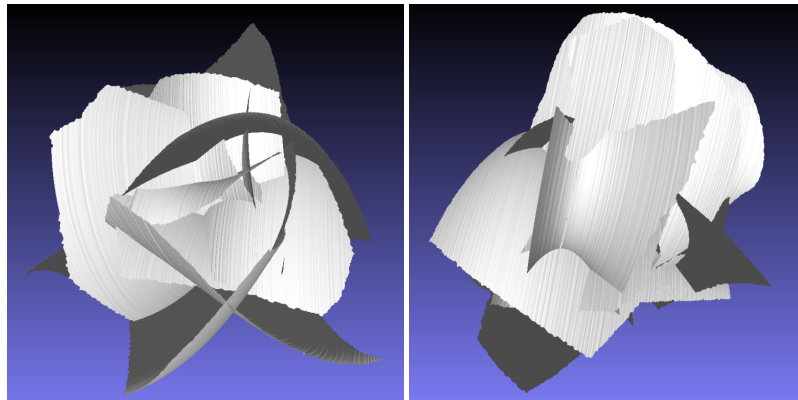


Figure 1: Two views of an unorganized pile of sherds from a synthetic pot broken into 10 pieces.

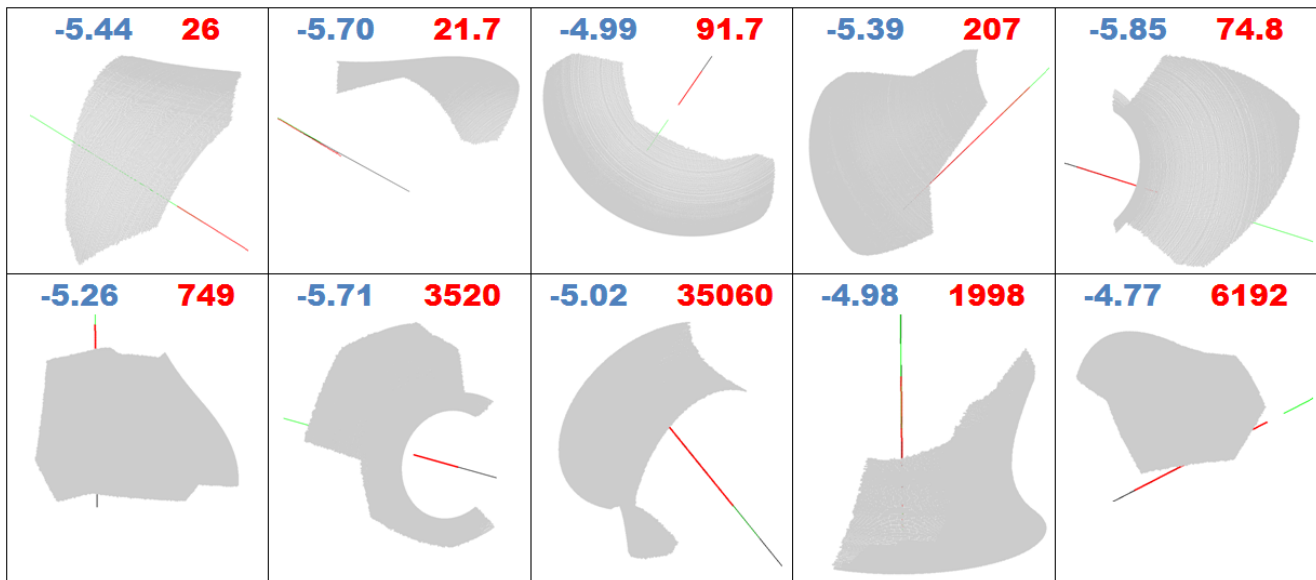


Figure 2: Blue (*left*) and red (*right*) numbers are respectively sufficiency and distinctiveness for the axis estimation. Small blue values mean high sufficiency and high red values mean high distinctiveness. If the distinctiveness is bigger than 3.0, the system assumes that the fragment has enough information for axis estimation. Blue points are center of circles fit to points within thick planar layers which are perpendicular to axis. Red points are the inliers for axis estimation (a subset of the blue points). Inlier blue points are not displayed. The black line is the estimated axis. The green line is the true axis from which the synthetic pot was generated.

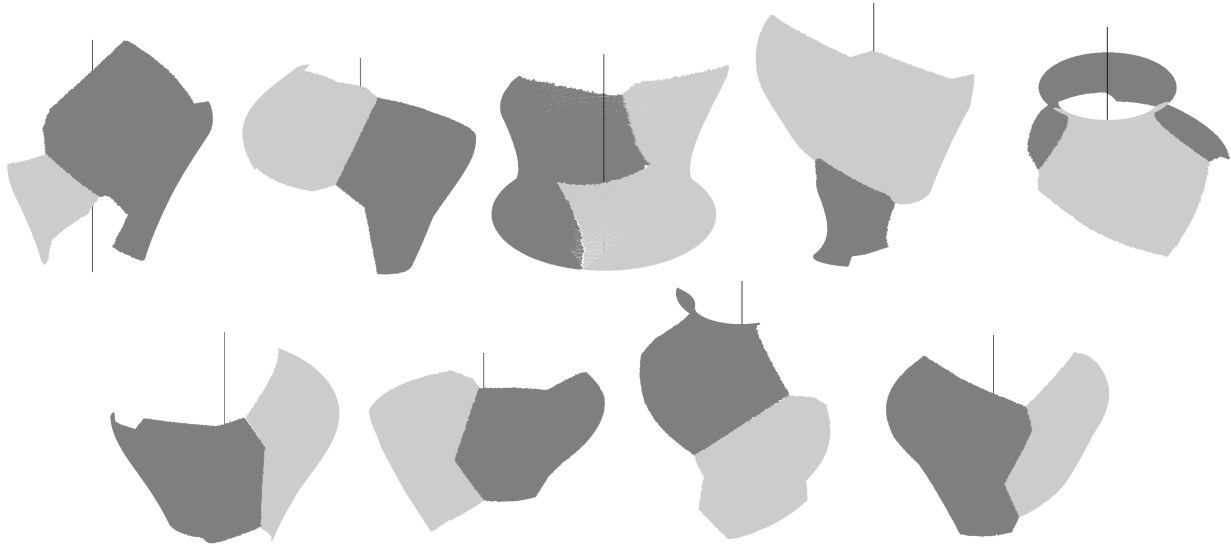


Figure 3: Final pairs with *axis-based* matching method. The black line is the common axis of symmetry of two matching fragments.

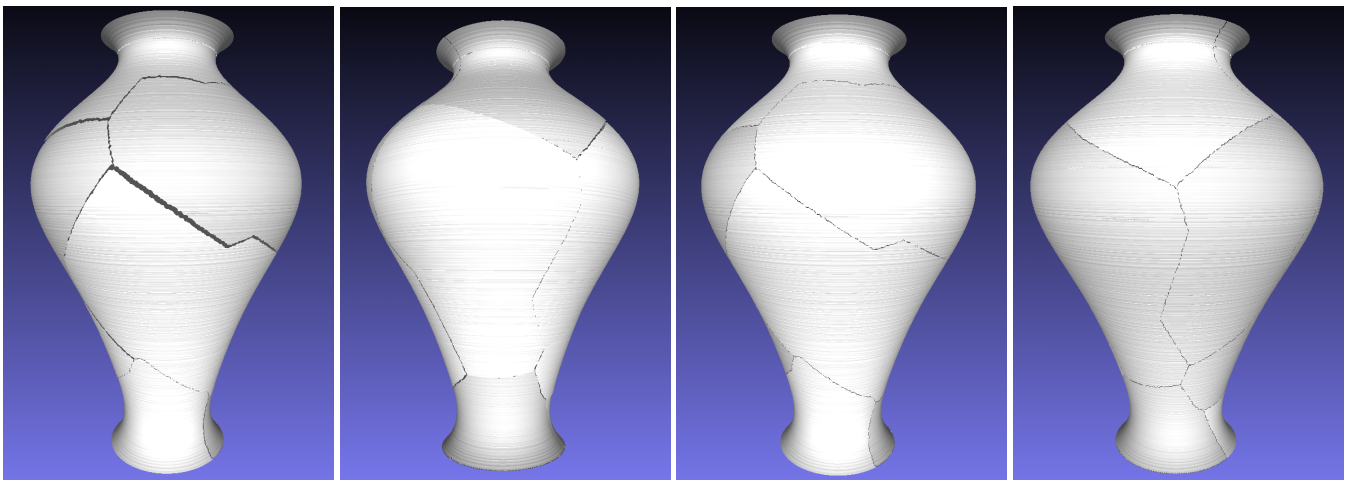


Figure 4: Final configurations (left two figures) and ground truth (right two figures) in different views.

2. Experiments with synthetic data (data1, 17 fragments)

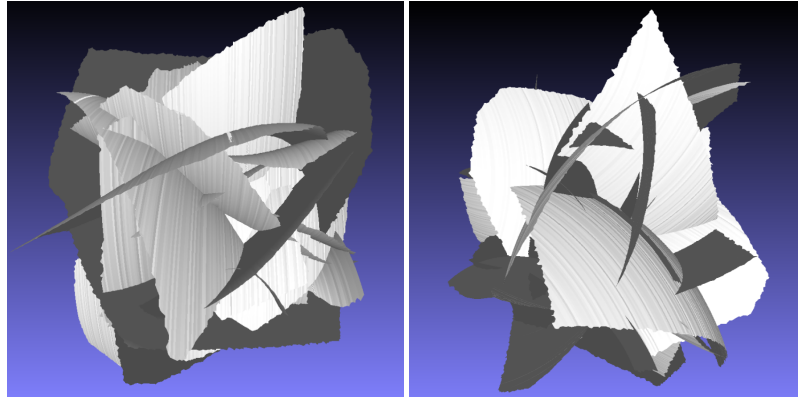


Figure 5: Two views of an unorganized pile of sherds from a synthetic pot broken into 17 pieces.

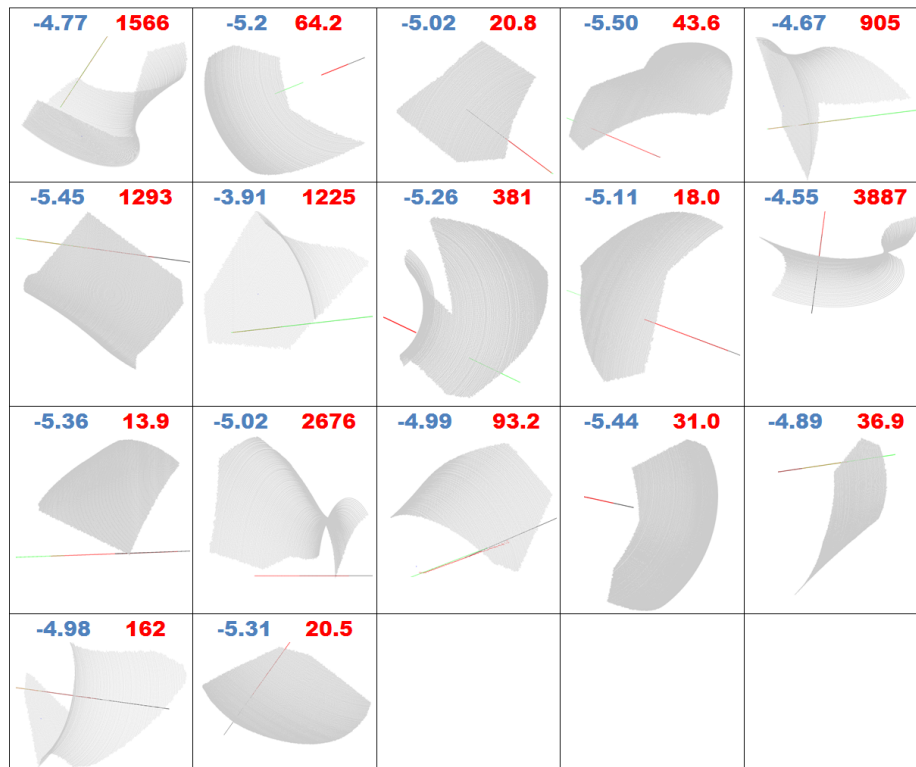


Figure 6: Blue (*left*) and red (*right*) numbers are respectively sufficiency and distinctiveness for the axis estimation. Small blue values mean high sufficiency and high red values mean high distinctiveness. If the distinctiveness is bigger than 3.0, the system assumes that the fragment has enough information for axis estimation. Blue points are center of circles fit to points within thick planar layers which are perpendicular to axis. Red points are the inliers for axis estimation (a subset of the blue points). Inlier blue points are not displayed. The black line is the estimated axis. The green line is the true axis from which the synthetic pot was generated.

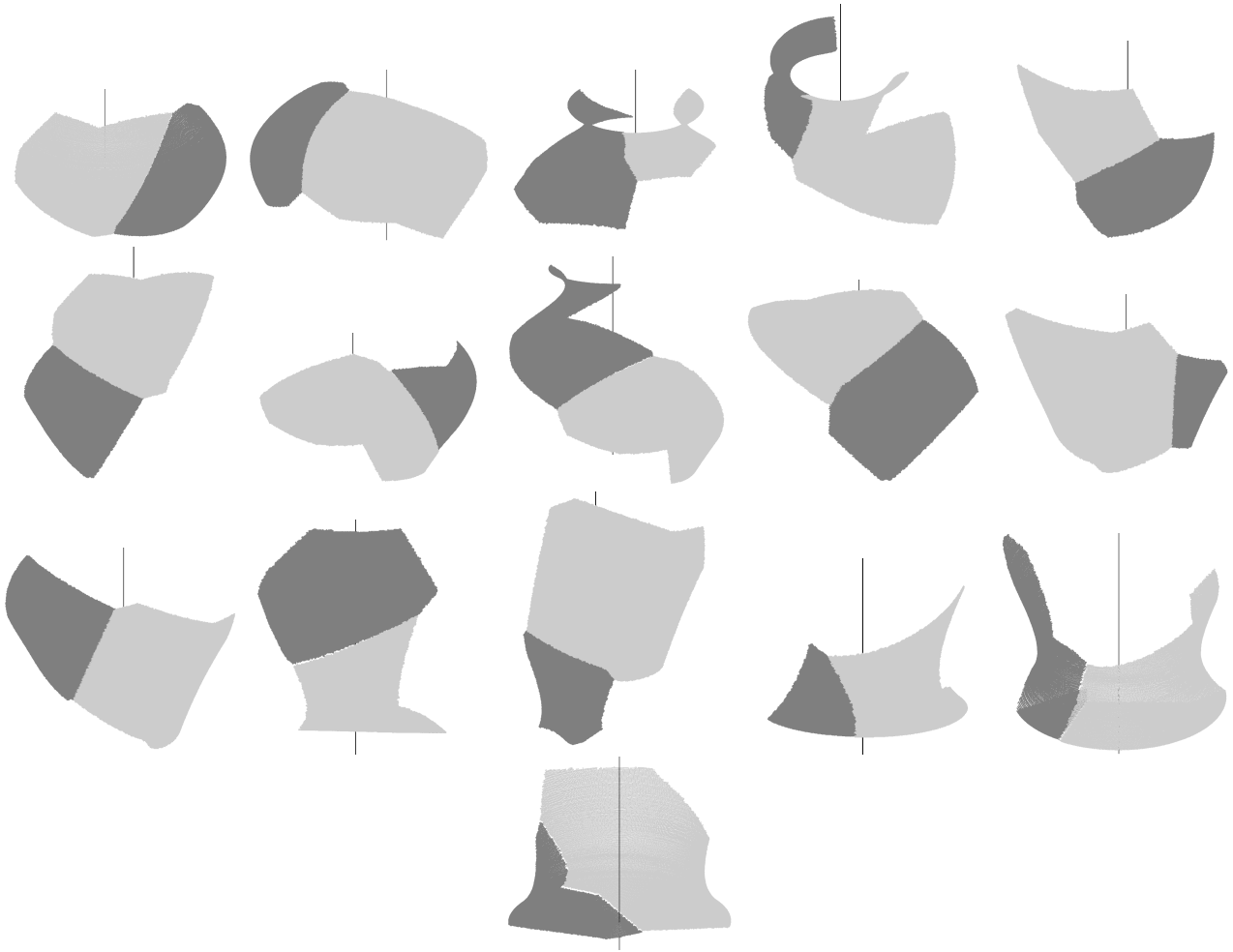


Figure 7: Final pairs with *axis-based* matching method. The black line is the common axis of symmetry of two matching fragments.

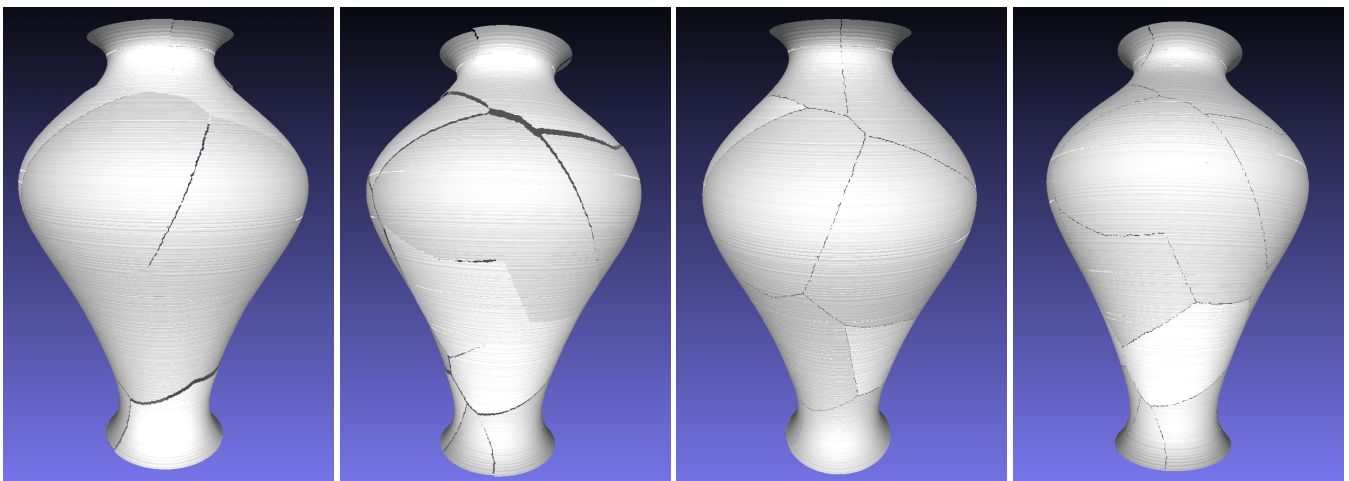


Figure 8: Final configurations (left two figures) and ground truth (right two figures) in different views.

3. Experiments with synthetic data (data1, 23 fragments)

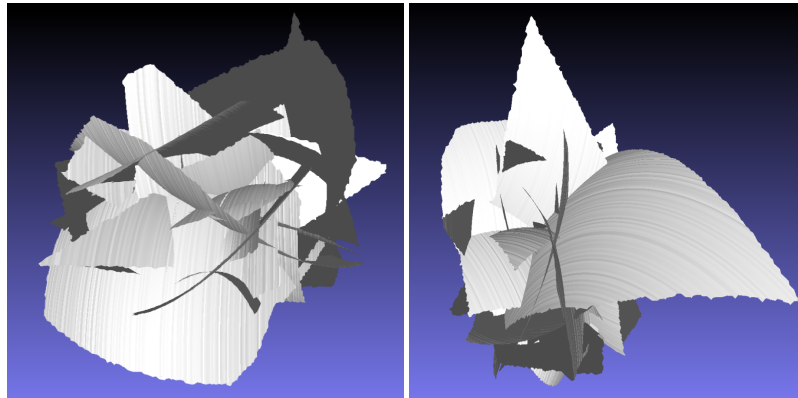


Figure 9: Two views of an unorganized pile of sherds from a synthetic pot broken into 23 pieces.

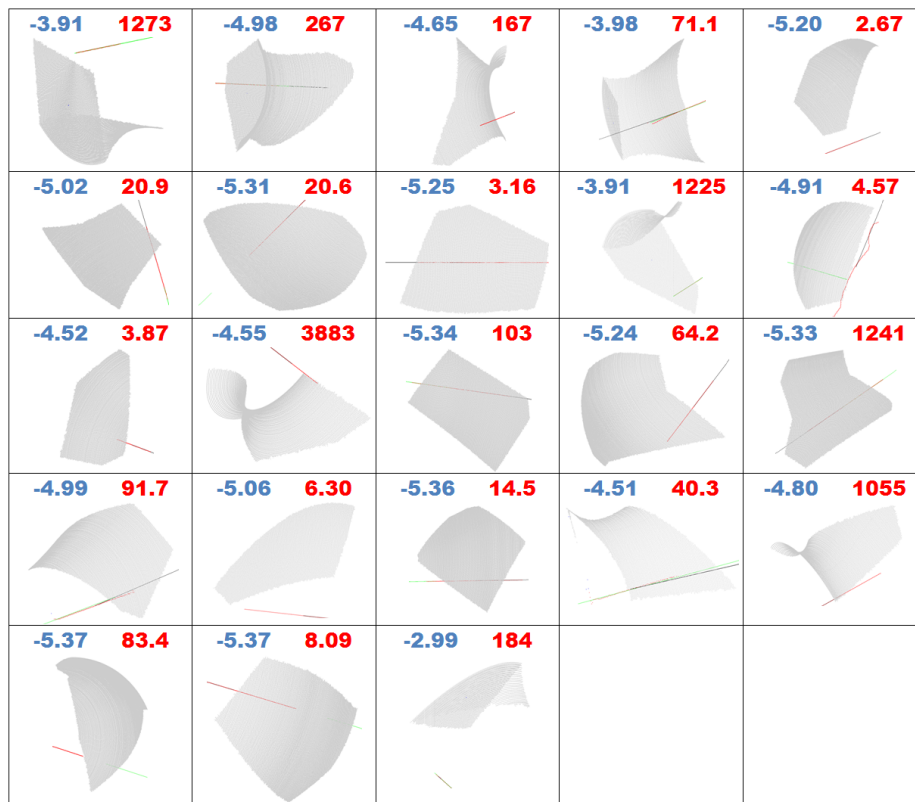


Figure 10: Blue (*left*) and red (*right*) numbers are respectively sufficiency and distinctiveness for the axis estimation. Small blue values mean high sufficiency and high red values mean high distinctiveness. If the distinctiveness is bigger than 3.0, the system assumes that the fragment has enough information for axis estimation. Blue points are center of circles fit to points within thick planar layers which are perpendicular to axis. Red points are the inliers for axis estimation (a subset of the blue points). Inlier blue points are not displayed. The black line is the estimated axis. The green line is the true axis from which the synthetic pot was generated.

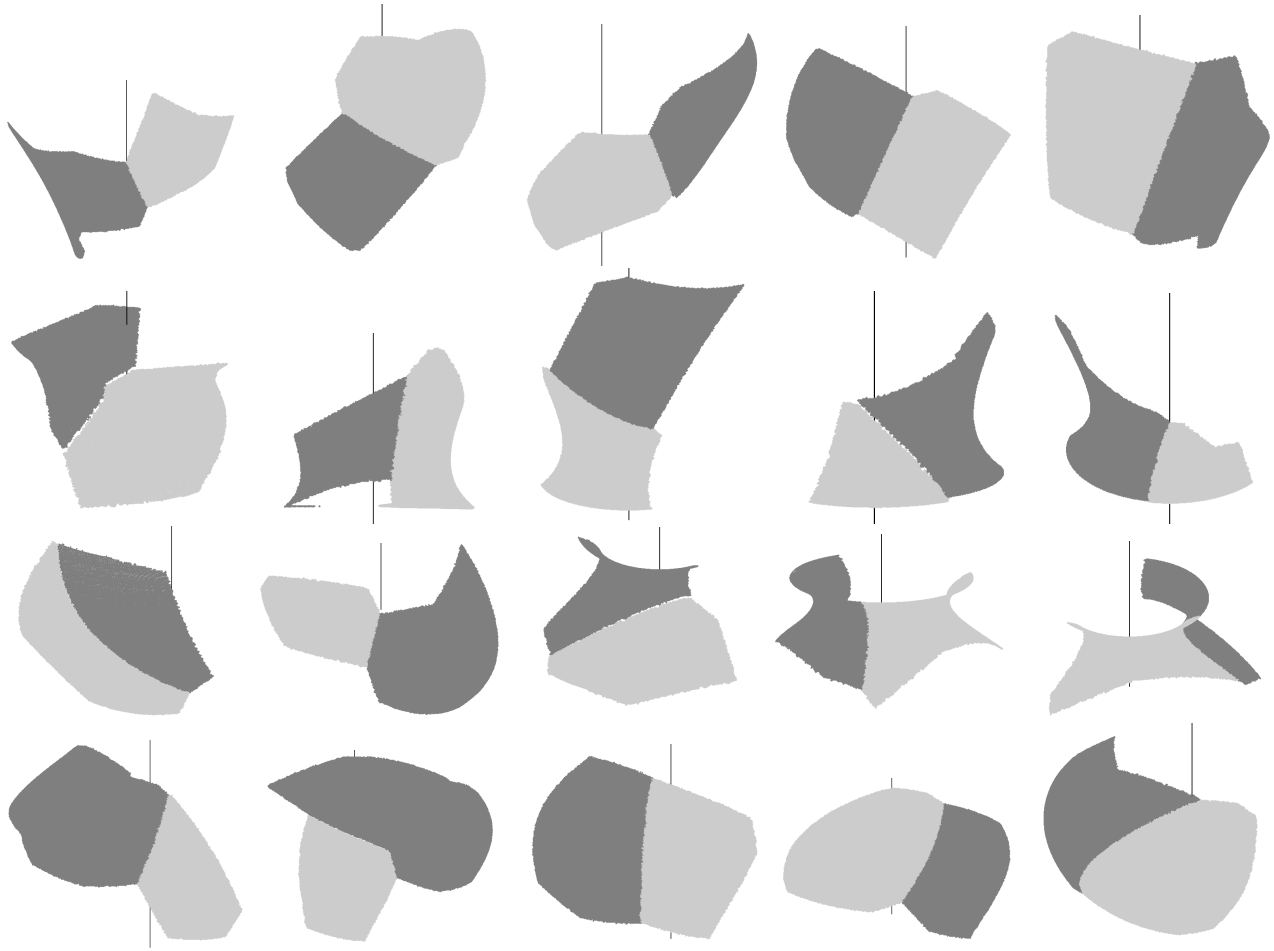


Figure 11: Final pairs with *axis-based* matching method. The black line is the common axis of symmetry of two matching fragments.

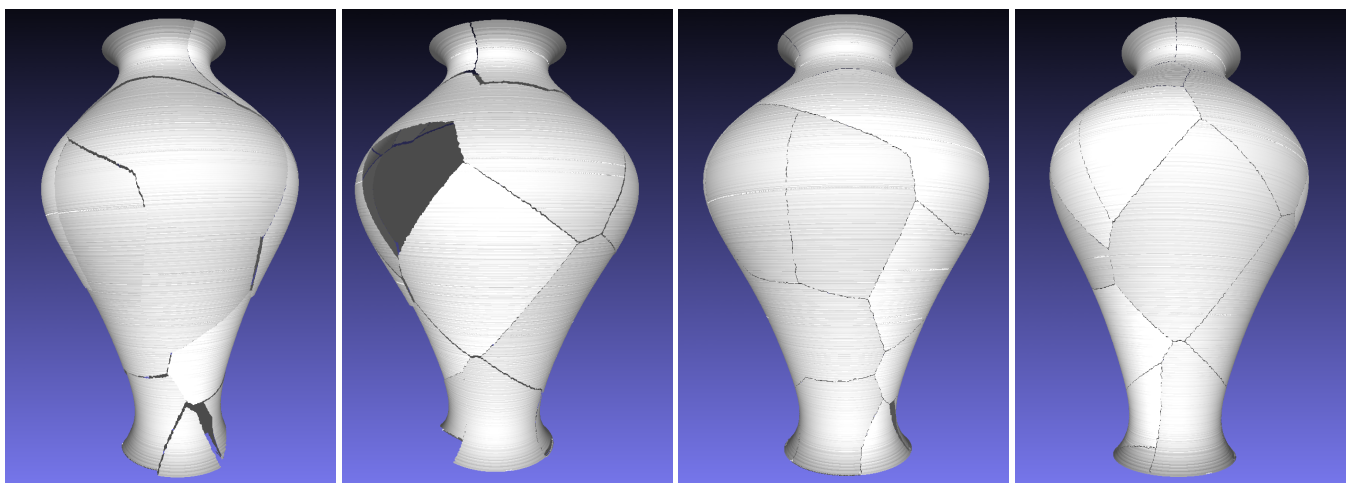


Figure 12: Final configurations (left two figures) and ground truth (right two figures) in different views.

4. Experiments with synthetic data (data1, 30 fragments)

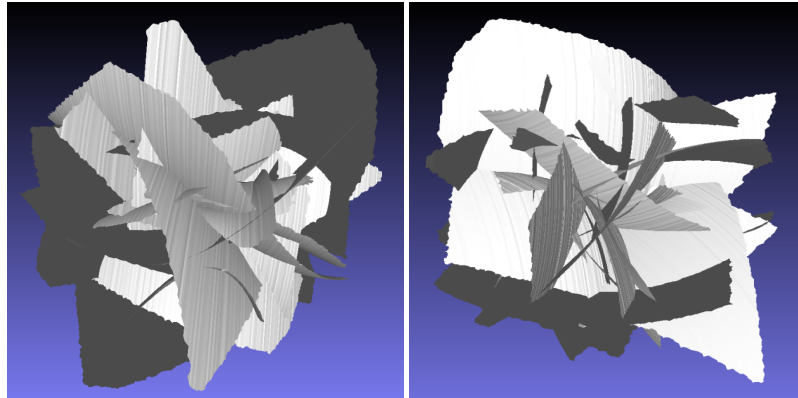


Figure 13: Two views of an unorganized pile of sherds from a synthetic pot broken into 30 pieces.

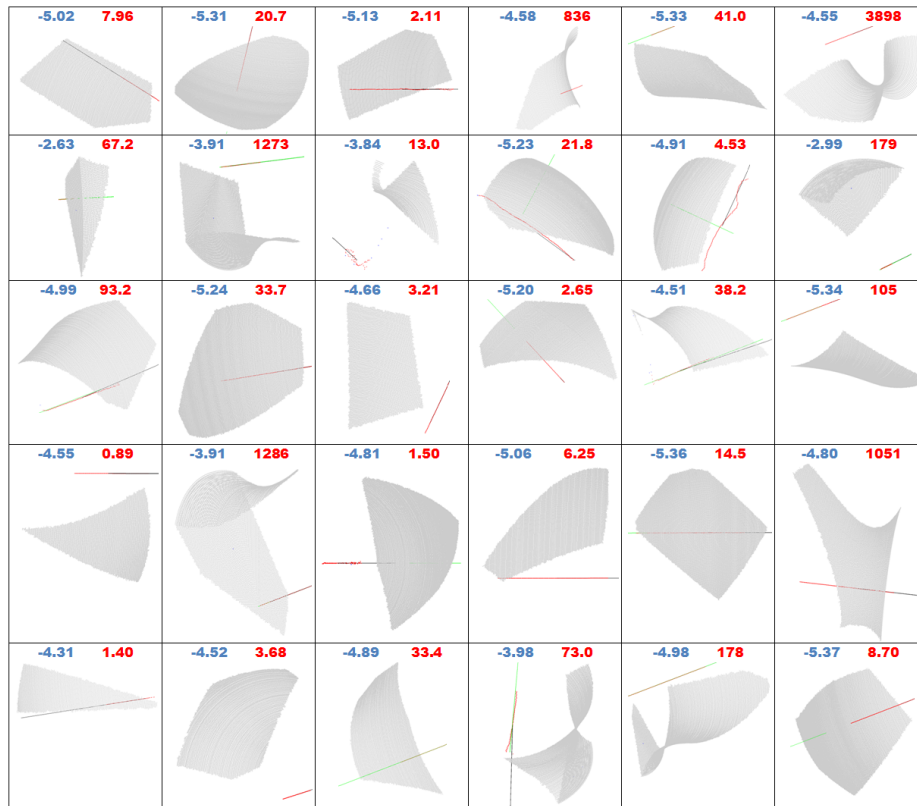


Figure 14: Blue (*left*) and red (*right*) numbers are respectively sufficiency and distinctiveness for the axis estimation. Small blue values mean high sufficiency and high red values mean high distinctiveness. If the distinctiveness is bigger than 3.0, the system assumes that the fragment has enough information for axis estimation. Blue points are center of circles fit to points within thick planar layers which are perpendicular to axis. Red points are the inliers for axis estimation (a subset of the blue points). Inlier blue points are not displayed. The black line is the estimated axis. The green line is the true axis from which the synthetic pot was generated.

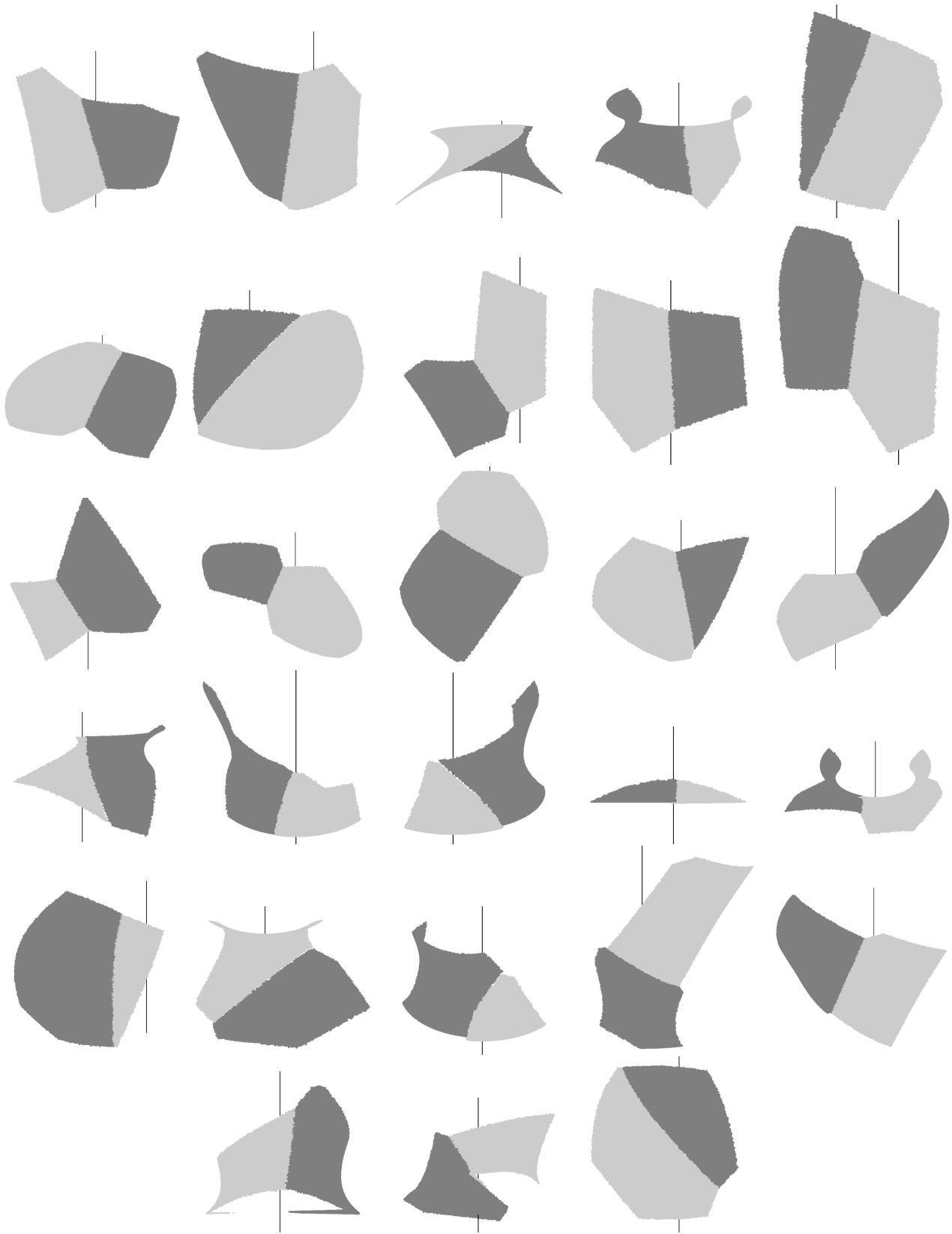


Figure 15: Final pairs with *axis-based* matching method. The black line is the common axis of symmetry of two matching fragments.

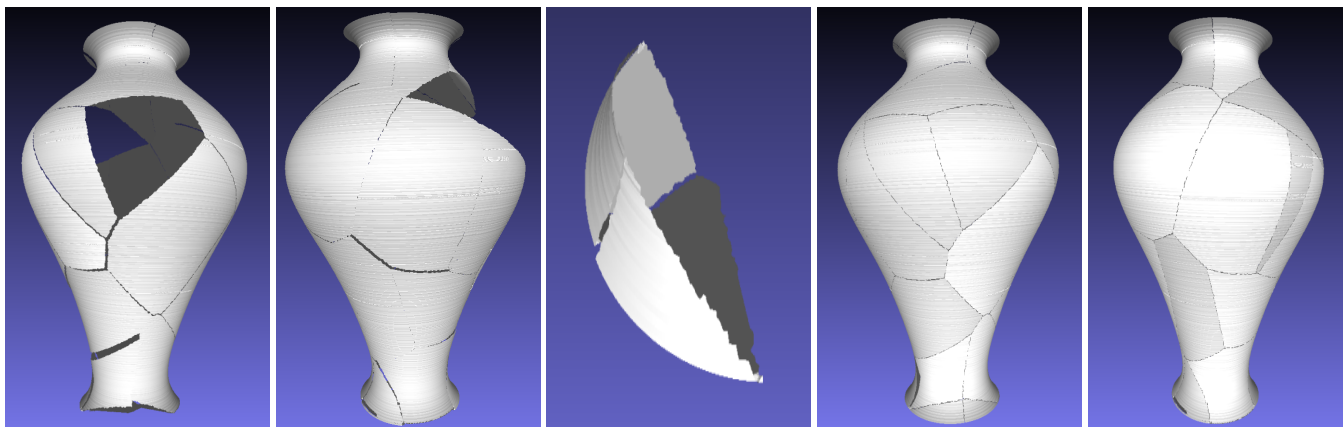
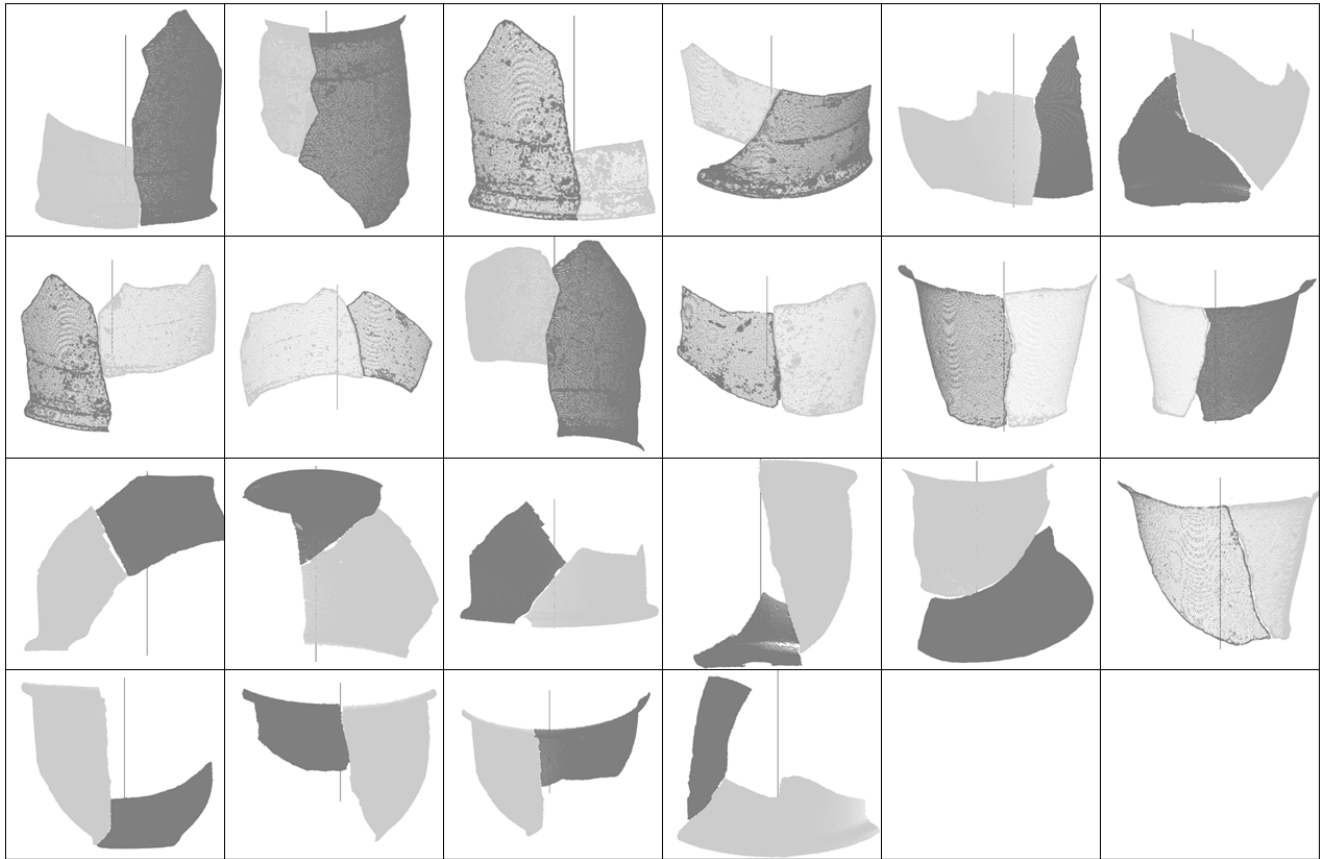


Figure 16: Final configurations (left three figures) and ground truth (right two figures) in different views. Here, the system returns 2 configurations from the fragments: the first two views are from the larger configuration, while the third view shows a close-up of the smaller configuration.

5. Experiments with real data (data2 and data3)



Figure 17: Blue (*left*) and red (*right*) numbers are respectively sufficiency and distinctiveness for the axis estimation. Small blue values mean high sufficiency and high red values mean high distinctiveness. If the distinctiveness is bigger than 3.0, the system assumes that the fragment has enough information for axis estimation. Blue points are center of circles fit to points within thick planar layers which are perpendicular to axis. Red points are the inliers for axis estimation (a subset of the blue points). Inlier blue points are not displayed. The black line is the estimated axis.



(a)



(b)

Figure 18: (a) Final pairs with *axis-based* matching method, and (b) final pairs with *break curve* based matching method.

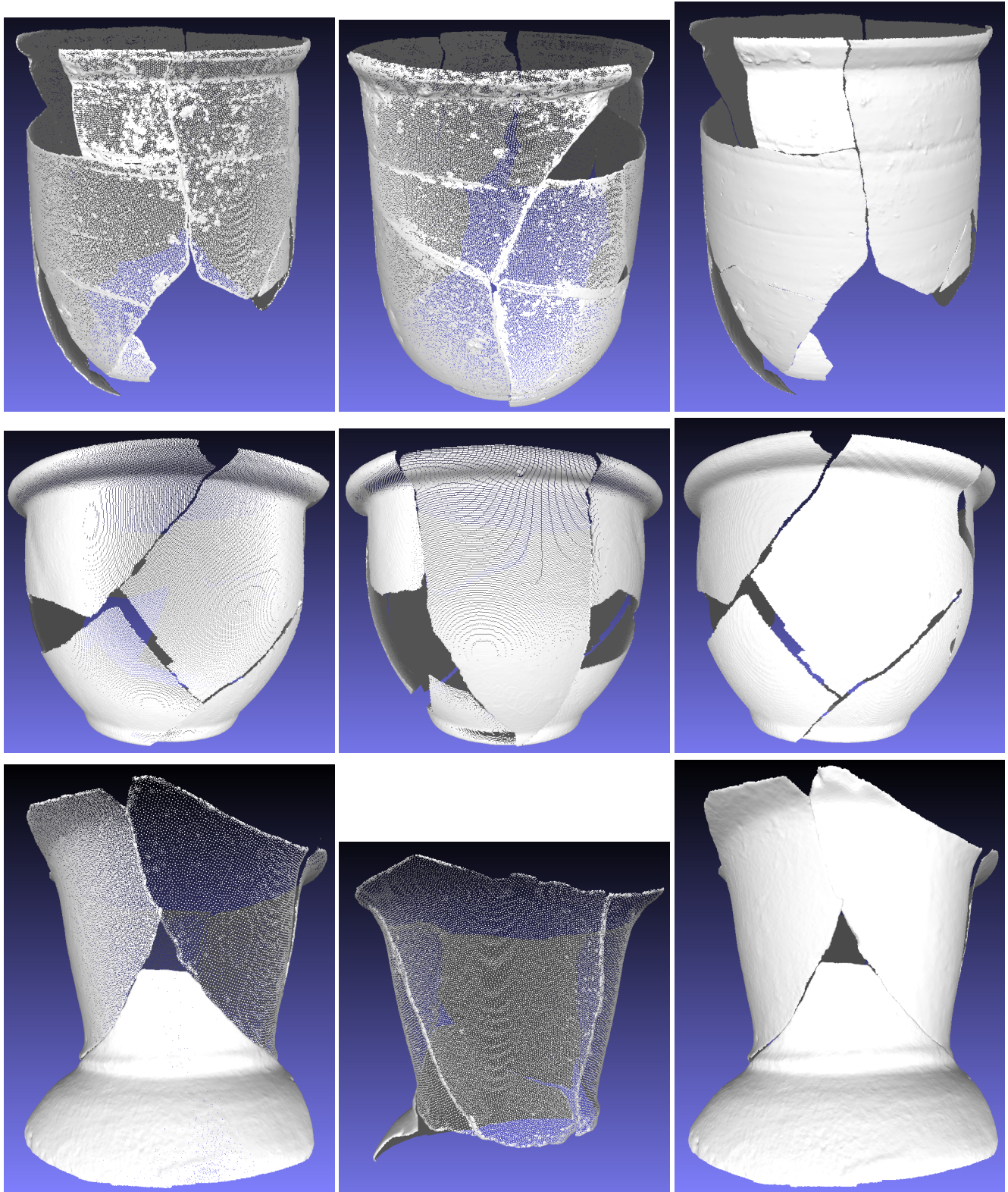


Figure 19: Three configurations out of 48 total fragments. From *top* to *bottom*: 16, 10 and 5 pieces for each configuration.