Projective and Direct Euclidean Reconstruction

With knowledge of the relative orientation, spatial object coordinates can be triangulated from corresponding image points. If the parameters of the interior orientation are unknown, then only a projective reconstruction is possible. Using at least five control points, this intermediate result can be transformed into a Euclidean reconstruction.

Task 1 – Projective Reconstruction

Since the manual matching of image points is quite laborious and monotonous, a text file bh.dat with many homologous image points is made available for the image pair showing the bust of BEETHOVEN.

a) Read the homologous image coordinates *x1* ↔ *x2* in the format *(x1, y1, x2, y2)*

b) Implement a new function, which defines two corresponding projection matrices $\boldsymbol{P_N}$ and $\boldsymbol{P'}$ by means of $\boldsymbol{F}$.

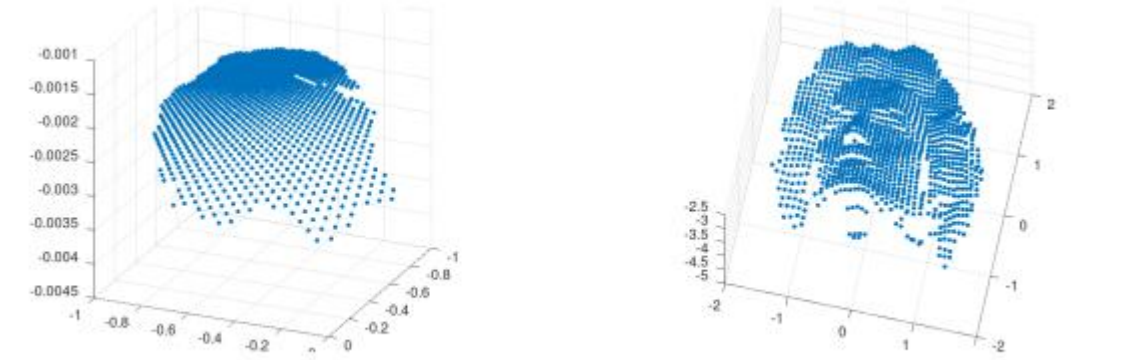
c) Write a function for the linear triangulation of projective object points $\boldsymbol{X_{P1}}$ and visualize the computed spatial object coordinates.

Task 2 – Direct Euclidean Reconstruction

a) Read the *control point* information from the provided file pp.dat in the format *(x1, y1, x2, y2, XE, Y E, ZE)* and triangulate the projective object points $\boldsymbol{X_{P2}}$ from the five homologous image points *x1* ↔ *x2* using the already computed projection matrices $\boldsymbol{P_N}$ and $\boldsymbol{P'}$. The values *XE, Y E, ZE* refer to the Euclidean object points $\boldsymbol{X_E}$.

b) Extend the algorithm of the planar 2D homography to a *spatial 3D homography* $\boldsymbol{H}$. Determine the spatial transformation of the five projective object points $\boldsymbol{X_{P2}}$ to the corresponding Euclidean object points $\boldsymbol{X_E}$.

c) Apply this transformation $\boldsymbol{H}$ to all object points of your projective reconstruction $\boldsymbol{X_{P1}}$ and visualize the result of the Euclidean reconstruction spatially.



(a) Projective Reconstruction (b) Euclidean Reconstruction