Vision 1 - Intro + Camera models + Calibration

1. Projection
   1.1. What size if the projection matrix P?
   1.2. If we have a 3D point M and a projection matrix P, how do we compute the corresponding pixel location where the camera will see the 3D point? Give steps.
   1.3. Given the projection matrix (P) and a 3D point compute where that point will be seen in the camera.
      1.3.1. $P = \begin{pmatrix} 1000 & 0 & 500 & 0 \\ 0 & 1000 & 500 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix}; M = \begin{bmatrix} -400 \\ 300 \\ 1000 \end{bmatrix}$
      1.3.2. $P = \begin{pmatrix} 0 & -500 & -1000 & -190000 \\ 1000 & -500 & 0 & -120000 \\ 0 & -1 & 0 & -300 \end{pmatrix}; M = \begin{bmatrix} 60 \\ -900 \\ -200 \end{bmatrix}$
   1.4. If we have m (2D point on image plane), can we compute M (3D point)? (If yes: How?, if no: Why not?)
   1.5. What is the meaning/use of the individual intrinsic parameters $(f, \alpha_u, \alpha_v, s, u_0, v_0)$?
   K*A = $\begin{pmatrix} f * \alpha_u & f * s & u_0 & 0 \\ 0 & f * \alpha_v & v_0 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix}$
   1.6. What are a camera's extrinsic parameters? What do they model?
2. Distortion
   2.1. What is the name of the two distortion models we discussed?
   2.2. Why can the distortion models not be integrated into the projection matrix? (Why do these two components (distortion, projection) need to be handled separately?)
3. Calibration
   3.1. How does one of the three discussed camera calibration methods work (choose which one you want to describe)?
4. Projective space
   4.1. What is the inhomogeneous version of

$$\begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 4 \\ 2 \\ 2 \end{bmatrix}, \begin{bmatrix} 6 \\ 4 \\ -1 \end{bmatrix}, \begin{bmatrix} 5 \\ 3 \\ 0.5 \end{bmatrix}, \begin{bmatrix} 1 \\ 10 \\ -3 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ -4 \\ 1.1 \\ 2 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ -1 \\ 10 \end{bmatrix}, \begin{bmatrix} -15 \\ 3 \\ 6 \\ 3 \end{bmatrix}$$

   4.2. Which of the points (p) lie on the line (l) (points and line are described in projective 2 space (P2))?

$$l = \begin{bmatrix} 1 \\ 2 \\ -3 \end{bmatrix}, p = \left\{ \begin{bmatrix} 3 \\ 0 \\ 1 \end{bmatrix} \begin{bmatrix} 6 \\ 0 \\ 2 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 110 \\ -40 \\ 10 \end{bmatrix} \right\}$$

   4.3. What is the geometric interpretation of a projective space point with a zero as last entry? (e.g., $[a \quad b \quad 0]^T, [c \quad d \quad e \quad 0]^T$)