A paraperspective projection is defined as follows. (1) First, a parallel projection along the constant direction $\mathbf{d} = [d_x, d_y, 1]^T$ is applied to map a 3D point P onto a point P' of the frontal plane Π (i.e. Π is parallel to the image plane), (2) then a perspective projection is employed to map P' to the image point p. If the distance between the camera center C and Π is Z_0, the distance between the camera center C and the image plane is f, the CCD scale factor is s_x pixel/unit length and s_y pixel/unit length, the principal point is (u_0, v_0), please derive the 2x4 camera matrix M for this paraperspective projection so that $p = MP$ or $[x, y]^T = M[X, Y, Z, 1]^T$.

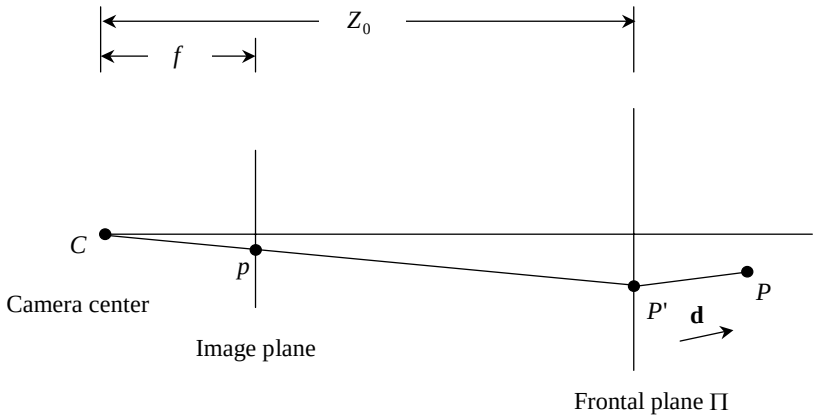

Figure 1. The paraperspective projection.