Pix4D camera definition

The definition of the internal parameters of the camera is realized such that it is independent on the physical size of the imaging sensor. This means also that our definition can be applied even if the sensor dimension is unknown or is changed.

Pix4D	**Brown 1964**	**Heikkila 1997**	**Fraser 1997**
Projection A 3D-point (X,Y,Z) is projected to (x,y), i.e. to the virtual image plane located at (1,0,0) by: $x=\frac{X}{Z}, y=\frac{Y}{Z}$	**Projection** A 3D-point (X,Y,Z) is projected to (x,y), i.e. the image plane located at (f,0,0) by: $x=f\frac{X}{Z}, y=f\frac{Y}{Z}$	**Projection** A 3D-point (X,Y,Z) is projected to (x,y) , i.e. the image plane located at (f,0,0) by: $x=f\frac{X}{Z}, y=f\frac{Y}{Z}$	**Projection** A 3D-point (X,Y,Z) is projected to (x,y), i.e. the image plane located at (f,0,0) by: $x=f\frac{X}{Z}, y=f\frac{Y}{Z}$
Distortion **t**he distorted coordinates of the projected 3D-points are given by: $x_d=x(1+d_r+dt_x), x_d=y(1+d_r+dt_y)$ $d_r=r^2 rd_1+r^4 rd_2+r^6 rd_3$ $dt_x=2t_1 x y+t_2(r^2+2x^2)$ $dt_y=2t_2 x y+t_1(r^2+2y^2)$ $r^2=x^2+y^2$	**Distortion** **t**he distorted coordinates of the projected 3D-points are given by: $x_d=x(1+d_r+dt_x), x_d=y(1+d_r+dt_y)$ $d_r=r^2 rd_1+r^4 rd_2+r^6 rd_3$ $dt_x=2t_1 x y+t_2(r^2+2x^2)$ $dt_y=2t_2 x y+t_1(r^2+2y^2)$ $r^2=(x-x_0)^2+(y-y_0)^2$	**Distortion** **t**he distorted coordinates of the projected 3D-points are given by: $x_d=x(1+d_r+dt_x), x_d=y(1+d_r+dt_y)$ $d_r=r^2 rd_1+r^4 rd_2+r^6 rd_3$ $dt_x=2t_1 x y+t_2(r^2+2x^2)$ $dt_y=2t_2 x y+t_1(r^2+2y^2)$ $r^2=x^2+y^2$	**Distortion** **t**he distorted coordinates of the projected 3D-points are given by: $x_d=x(1+d_r+dt_x), x_d=y(1+d_r+dt_y)$ $d_r=r^3 rd_1+r^5 rd_2+r^7 rd_3$ $dt_x=2t_1 x y+t_2(r^2+2x^2)$ $dt_y=2t_2 x y+t_1(r^2+2y^2)$ $r^2=(x-x_0)^2+(y-y_0)^2$
Conversion to pixels Only digital sensors modeled with squared, non skewed pixel $p_x=f*x_d+c_x, p_y=f*y_d+c_y$ with the focal length [pixel] and the principle point c_x, c_y [pixel]	**Conversion to pixels** The projections on the image sensor are scaled to fit the pixels of the image	**Conversion to pixels** Modeled with non squared, and non skewed pixel $p_x=f_x*x_d+c_x, p_y=f_f*y_d+c_y$ with the focal length [pixel] and the principle point c_x, c_y [pixel]	**Conversion to pixels** The projections on the image sensor are scaled to fit the pixels of the image
All parameters do not require the knowledge of the sensor size. The formulations is purely in pixels. If the sensor size is known, f, c_x, c_y can be converted into physical units [mm].	**Conversion to Pix4D** $x_0=0, y_0=0$ $rd_n(Pix4D)=rd_n f^{2n}$ $t_n(Pix4D)=t_n f^{2n}$	**Conversion to Pix4D** $rd_n(Pix4D)=rd_n f^{2n}$ $t_n(Pix4D)=t_n f^{2n}$	**Conversion to Pix4D** $x_0=0, y_0=0$ needs polynomial fit to account for the different power in the radial distortion d_r