Reprojection

# Reprojection

First each point in 3d coordinate space is translated into the camera’s reference frame by subtracting

.

It is then transformed under the camera’s rotation matrix

.

Where the rotation matrix is given by 3 Euler angles ()

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The coordinates are then taken into the camera plane by division by the component of . They are scaled by representing the focal length of the simulated camera.

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In the normalised camera plane, these coordinates are subjected to radial and tangential distortions. The quantity is of use for these.

,

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Adding these distortion effects to yields the normalised distorted coordinates, which can finally be scaled to the final image resolution and offset to centre at the middle of the image.

In all, the reprojection function .

# The Jacobian

The Jacobian of is a matrix for a single point in space and a single camera.

where is the Euler angle vector, is the camera’s position, and is the point’s position.

## Point Position

First consider the effect of the point’s position .

## Camera Position

Quite naturally the derivatives with respect to the camera’s coordinates are the negative of those for the point’s coordinates, as moving the point by is the same as moving the camera by .

## Camera Rotation

represents the Jacobian of the 2d vector with respect to the 3 Euler coordinates, hence it is a matrix. This can be broken into , a matrix and , a matrix, whose product gives the matrix expected.

Also need