

Discussion on Stereovision Formulae

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Background

I am an undergraduate researcher of the Key Laboratory of Machine Perception, Peking University, supervised by Professor Hongbin Zha. My partners, Xiaohan Jin and Fei Xue, together with I decided to do some research on *Effect Correction Based on Scene Analysis for 3D Movies*. We think your paper published on *IEEE Computer Graphics and Applications* in 2011 is of great help.

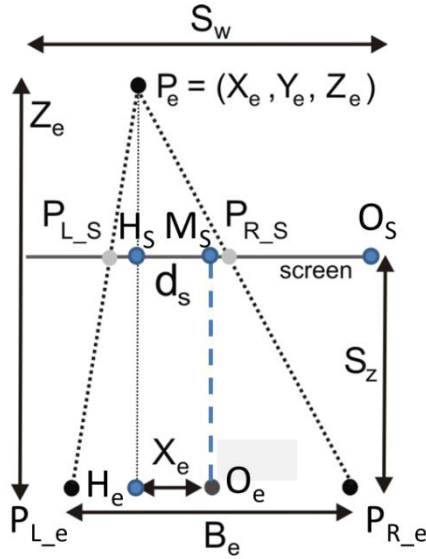
Prerequisites

We noticed that some formulae in *A Viewer-Centric Editor for 3D Movies* are different from those in *A Viewer-Centric Editor for Stereoscopic Cinema*, and I think that the reason may be some minor difference on definition. In the following discussion, we take *A Viewer-Centric Editor for Stereoscopic Cinema* as standard, regard all the coordinates as absolute values, and then try to explain these formulae.

Discussion

Considering saving your time, I won't prove every formula here. Only what we think different from you will be proposed.

The question we are going to solve is, knowing the cinema parameters and the disparity, to calculate the 3D position that the viewer perceives.



We start from Z_e . $\Delta P_e P_{L_S} P_{R_S}$ is similar to $\Delta P_e P_{L_e} P_{R_e}$, thus

$$\frac{Z_e - S_z}{Z_e} = \frac{P_e H_S}{P_e H_e} = \frac{P_{L_S} P_{R_S}}{P_{L_e} P_{R_e}} = \frac{d_s}{B_e}$$

We get

$$Z_e = \frac{B_e S_z}{B_e - d_s}$$

Or

$$Z_e = \frac{B_e S_z}{B_e - d_s r}$$

Different from your

$$Z_e = \frac{B_e S_z}{B_e - d_s S_r}$$

Then we deal with X_e . $\Delta P_e P_{L_S} H_S$ is similar to $\Delta P_e P_{L_e} H_e$, thus

$$\frac{Z_e - S_z}{Z_e} = \frac{P_e H_S}{P_e H_e} = \frac{P_{L_S} H_S}{P_{L_e} H_e} = \frac{P_{L_S} O_S - M_S O_S - H_S M_S}{P_{L_e} O_e - H_e O_e} = \frac{c_{L_S} - \frac{S_w}{2} - X_e}{\frac{B_e}{2} - X_e}$$

We get

$$X_e = \frac{Z_e}{S_z} \left[c_{L_S} - \frac{S_w}{2} - \frac{B_e}{2} \right] + \frac{B_e}{2}$$

Or

$$X_e = \frac{Z_e}{S_z} \left[S_r \left(c_L - \frac{W}{2} \right) - \frac{B_e}{2} \right] + \frac{B_e}{2}$$

Different from your

$$X_e = \frac{Z_e}{S_z} \left[S_r \left(c_{L_S} - \frac{W}{2} \right) - \frac{B_e}{2} \right] + \frac{B_e}{2}$$

All symbols that appear are identical to what you defined.

Variable name	Geometric meaning
(X_c, Y_c, Z_c)	Real world coordinates of point P
(X_e, Y_e, Z_e)	Perceived coordinates of P
$\mathbf{p}_L = (c_L, r_L)$	Left image coordinates of P (similarly for \mathbf{p}_R)
$\mathbf{p}_{LS} = (c_{LS}, r_{LS})$	Left screen coordinates of P (similarly for \mathbf{p}_{RS})
B_e	Eye baseline
B_c	Camera baseline
d	Image disparity
d_S	Screen disparity
f_c	Camera focal length
S_z	Viewer screen distance
S_w	Screen width
V_c	Horizontal shift (vergence)
V_{c0}	Original vergence position
θ_c	Camera field-of-view
θ_{c0}	Original camera field-of-view
α_θ	Ratio change for FOV
B_{c0}	Original baseline
α_B	Ratio change for baseline
Z_s	Dolly (forward camera shift)
Z_{s0}	Original dolly position
α_Z	Ratio change for dolly

Correspondingly, \bar{c}_{LS} , \bar{c}_{RS} , \bar{d}_S , c'_{LS} , c'_{RS} and d'_S in formula (6) and (7) are supposed to be \bar{c}_L , \bar{c}_R , \bar{d} , c'_L , c'_R and d' .

This is not a big problem but I am looking forward to making everything solid. Please correct me if any of my idea is wrong.

Moreover

I sincerely hope you won't mind us taking your paper as reference. Though can't be as good as yours, we decided to realize an editing system that you proposed. We don't expect that your suggestive work provides open codes, but we do hope you can give us a software demo which we can play with. If this is still not possible, I will be grateful if you can tell us which tools you were using, for example, OpenCV, C#, MFC, Qt etc.

I've also written a HTML only for displaying the stereovision system and its parameter effects. If you are interested, please release the RAR file attached in the same folder. Have fun!

Thanks a lot for your time and rigorousness. Forgive me if I disturbed you so many times. XD