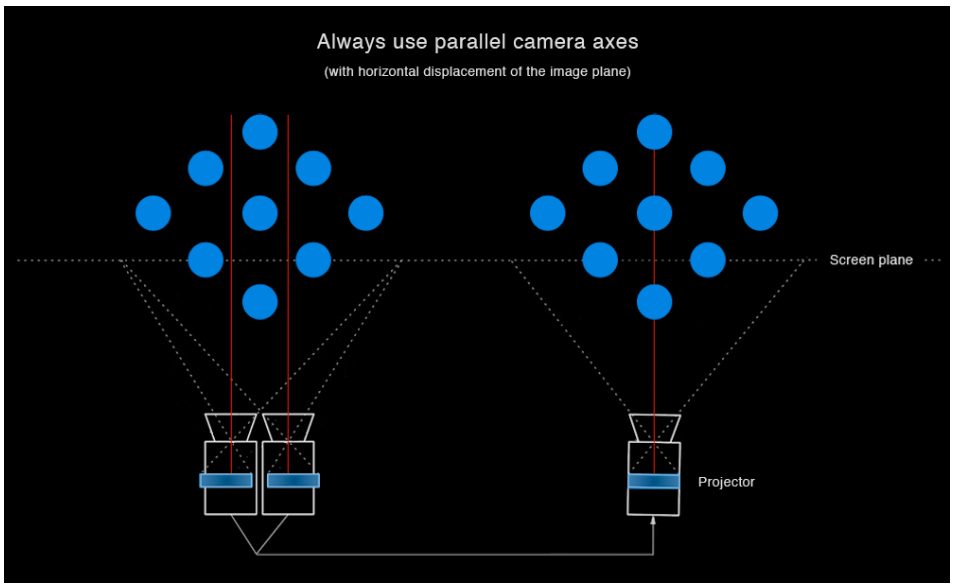
3D Camera Setup & Calculator

Rules & Formulas

Ten basic 3D rules

1. Think 3-Dimensional when you compose or choose your scene • The scene should always contain foreground, middle distance and background if possible.
2. The camera axes must always be parallel to avoid geometric distortion.
3. Never exaggerate your camera base (interaxial distance) • Use a 3D Calculator.
4. The near point distance has to be chosen very accurately.
5. The Left and Right image in a stereo pair must always be congruent in all aspects apart from horizontal parallax.
6. Never record stereo pairs with very high contrast.
7. Keep everything sharp in a stereo pair • The only exception is distant backgrounds.
8. Never violate the Stereo Window • The display screen frame must never cut off or touch an object in viewer space.
9. Never exceed 65 mm between the corresponding far points when you scale up a 3D image e.g. by projection • Adjust accordingly.
10. Always show 3D images and movies with a viewing distance of 1.5 to 2x the display width in a room with subdued ambient light.



Never use converged camera axes

It is a common misconception that 3D cameras should use converged camera axes (toed-in camera axes).

The 3D camera is not a substitute for your eyes. It is a tool, which produces an imitation of the original scene toward which your eyes function just as they would do with the real scene.

The converged camera axes model results in keystone distortion that introduces incorrect sizes of and distances between objects in the scene plus vertical offset between corresponding points in the Left and Right image. This means that you will never be able to look into the distance of the scene without severe discomfort. Finally, there is a risk of "depth plane curvature" - flat planes can appear bowed in the centre toward the camera. However, the keystone distortion can be corrected by a number of post-production software.

Since the camera axes converge on the area of interest the result is often that everything in the foreground and the background of the scene will go out of focus and get blurry. This is not acceptable because 3D is supposed to be sharp all over to let the spectator explore the scene just as in real life.

Always use a 3D camera setup with parallel camera axes because it will produce uniform and satisfying 3D images and movies under all conditions and with all types of subjects and let our eyes converge normally.

Calculation of camera base for Optimum depth effect from 100 mm to ∞

Formula with N defined and F as infinity

$b = \Delta (N / f - 1)$

Example

$b = 1{,}08 \times (2000 / 50 - 1) = 42{,}12$ mm

Calculation of camera base for Maximum depth effect from 100 mm to 900 mm

Formula with N and F defined

$b = \Delta / f \, (N / (F - N) + 1) \, (N - f)$

Example

$b = 1{,}08 / 50 \times (200 / (500 - 200) + 1) \times (200 - 50) = 5{,}40$ mm

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Calculation of camera base for Maximum depth effect from 1000 mm to ∞

Formula with N and F defined

$b = \Delta \, N \, F / f \, (F - N)$

Example

$b = 1{,}08 \times 2000 \times 10000 / 50 \times (10000 - 2000) = 54{,}00$ mm

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Parameters

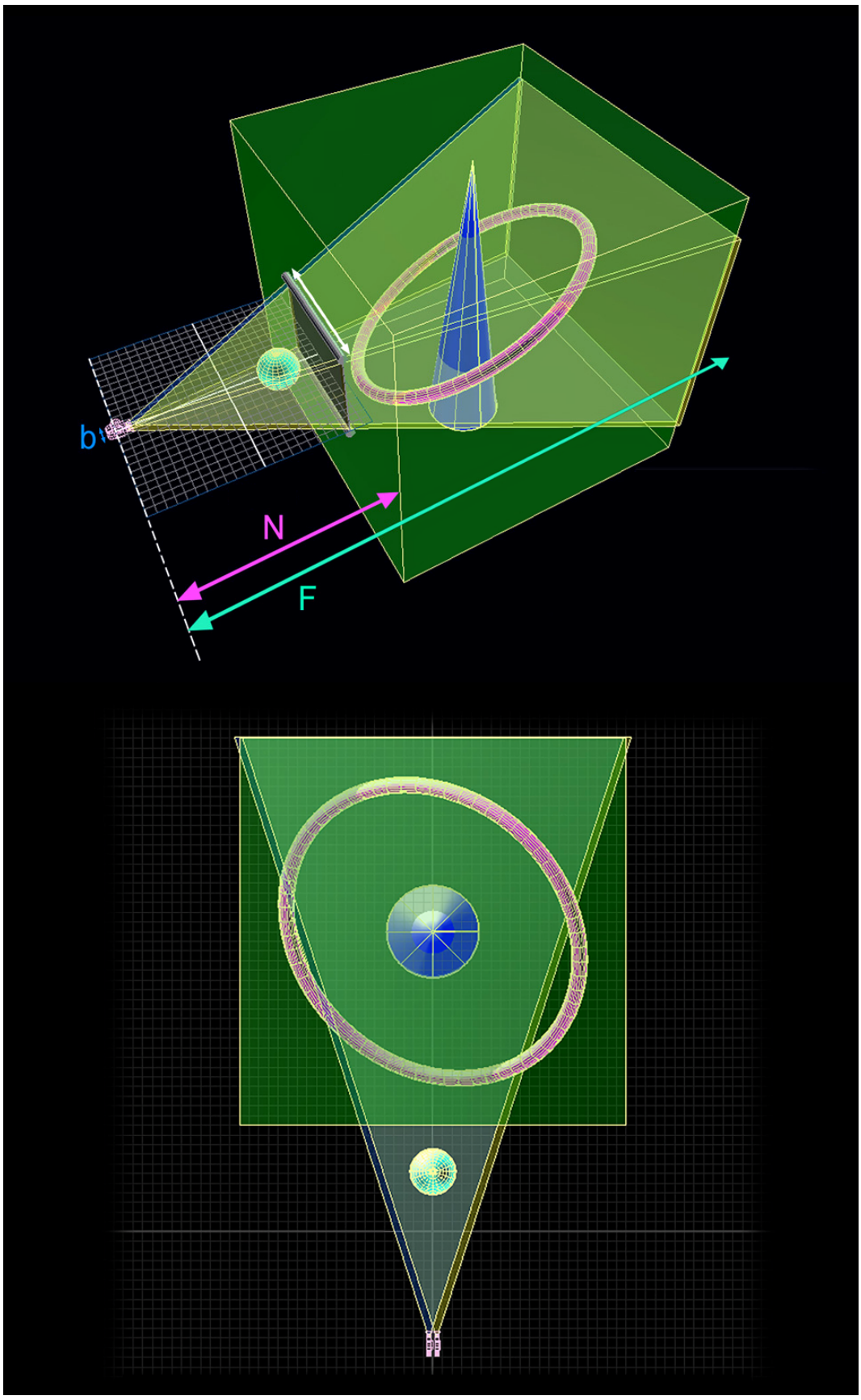
Values in millimeters unless otherwise mentioned

b	=	Camera base		
Δ	=	Parallax difference	• Normal 1,08 (3%)	• Maximum 1,62 (4,5%)
N	=	Near point distance		
F	=	Far point distance		
f	=	Focal length	• 35 mm	• 50 mm • 85 mm
FOV	=	Horizontal field of view	• 54,4° (54°)	• 39,6° (40°) • 23,9° (24°)

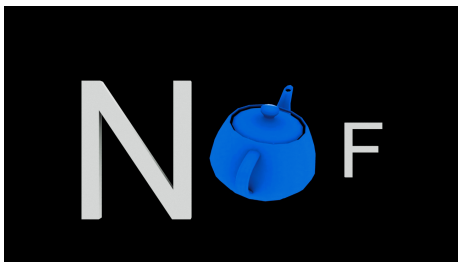
Normal parallax difference is Δ = 1,08 - equal to 3% of the image width.
Maximum parallax difference is Δ = 1,62 - equal to 4,5% of the image width.

It is recommended to use a lens with a focal length of either 35 mm, 50 mm or 85 mm with the 24 x 36 mm format or the corresponding FOV of these lenses with any other format because they have a horizontal FOV within the range of the human eyes binocular FOV of 60°.

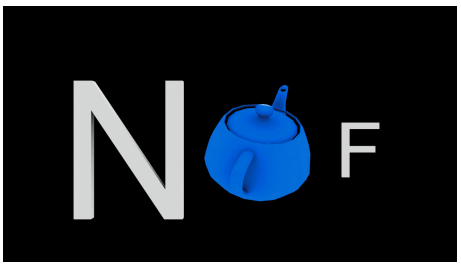
If you need to use another focal length than one of the specified in the examples formulas above, you can insert a different focal length with a FOV that doesn't exceed 60°.



Virtual 3D Camera Setup



Left Test image



Right Test image

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