
Technical Application Note TAN2006004

*General factors that affect the Censys3D™ coverage area
Revised April 12, 2006*

1.1. Subject

Technical Application Note (TAN2006003): General factors that affect the Censys3D™ coverage area.

1.2. Applicable Product(s)

- *Censys3D*
- *PGR Stereo Vision Products*

Consult our website (www.ptgrey.com/products/) for a full listing of PGR Stereo Vision products.

1.3. Application Note Description

The purpose of this Technical Application Note is to provide a comprehensive list of some of the general factors that can affect the coverage area of the Censys3D software.

1.3.1. Factors Affecting Coverage

With a stereo camera mounted on the ceiling, one can think of coverage area as a horizontal slice through the camera's field of view taken at a particular height, h_{max} , from the ground (see Figure 1). This rectangular cross-section represents the area in which a person of height h_{max} remains within the field of view of the camera. Outside of this area, the person's head is no longer visible and they may not be reliably detected. The coverage table below lists some typical mounting heights and coverage areas for a maximum person height of 2 metres. Width is the dimension along the camera's x-axis, and depth is along the camera's y-axis. To estimate coverage for other system configurations, you can download the [Censys3D™ Coverage Spreadsheet](#) (Microsoft Excel file).

When designing a system, a trade-off must be made between coverage and accuracy. To increase coverage, mounting height can be increased or focal length can be decreased. As a result, people will appear smaller in the camera image, thereby making it more difficult to distinguish them from the background in the image. As a general rule, it is always safer to opt for a lens with a shorter focal length since lowering the camera is usually easier than raising the ceiling. A camera with black-and-white sensors will provide the best stereo results with the least amount of computation since off-camera color processing does not have to be done.

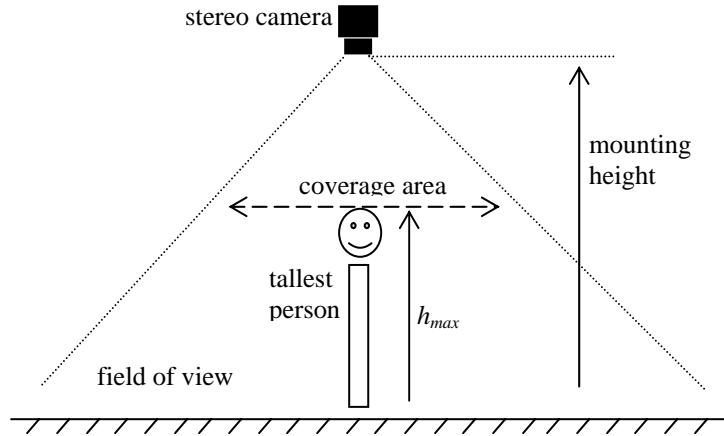


Figure 1: Camera field of view and Censys3D™ coverage

Table 1: Censys3D™ Coverage

Width		Depth		Mounting Height		Tallest Person		Focal Length	Camera Type
(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(mm)	
3.06	0.93	2.20	0.67	8.00	2.44	6.56	2.00	2	Bumblebee
5.46	1.66	4.00	1.22	9.00	2.74	6.56	2.00	2	Bumblebee
7.86	2.40	5.80	1.77	10.00	3.05	6.56	2.00	2	Bumblebee
10.26	3.13	7.60	2.32	11.00	3.35	6.56	2.00	2	Bumblebee
12.66	3.86	9.40	2.86	12.00	3.66	6.56	2.00	2	Bumblebee
15.06	4.59	11.20	3.41	13.00	3.96	6.56	2.00	2	Bumblebee
17.46	5.32	13.00	3.96	14.00	4.27	6.56	2.00	2	Bumblebee
19.86	6.05	14.80	4.51	15.00	4.57	6.56	2.00	2	Bumblebee
1.33	0.41	0.90	0.27	8.00	2.44	6.56	2.00	4	Bumblebee
2.53	0.77	1.80	0.55	9.00	2.74	6.56	2.00	4	Bumblebee
3.73	1.14	2.70	0.82	10.00	3.05	6.56	2.00	4	Bumblebee
4.93	1.50	3.60	1.10	11.00	3.35	6.56	2.00	4	Bumblebee
6.13	1.87	4.50	1.37	12.00	3.66	6.56	2.00	4	Bumblebee
7.33	2.23	5.40	1.65	13.00	3.96	6.56	2.00	4	Bumblebee
8.53	2.60	6.30	1.92	14.00	4.27	6.56	2.00	4	Bumblebee
9.73	2.97	7.20	2.19	15.00	4.57	6.56	2.00	4	Bumblebee
3.12	0.95	2.26	0.69	8.00	2.44	6.56	2.00	2	Digiclops
5.52	1.68	4.06	1.24	9.00	2.74	6.56	2.00	2	Digiclops
7.92	2.42	5.86	1.79	10.00	3.05	6.56	2.00	2	Digiclops
10.32	3.15	7.66	2.34	11.00	3.35	6.56	2.00	2	Digiclops
12.72	3.88	9.46	2.88	12.00	3.66	6.56	2.00	2	Digiclops
15.12	4.61	11.26	3.43	13.00	3.96	6.56	2.00	2	Digiclops
17.52	5.34	13.06	3.98	14.00	4.27	6.56	2.00	2	Digiclops
19.92	6.07	14.86	4.53	15.00	4.57	6.56	2.00	2	Digiclops
1.40	0.43	0.97	0.29	8.00	2.44	6.56	2.00	4	Digiclops
2.60	0.79	1.87	0.57	9.00	2.74	6.56	2.00	4	Digiclops
3.80	1.16	2.77	0.84	10.00	3.05	6.56	2.00	4	Digiclops
5.00	1.52	3.67	1.12	11.00	3.35	6.56	2.00	4	Digiclops
6.20	1.89	4.57	1.39	12.00	3.66	6.56	2.00	4	Digiclops

7.40	2.25	5.47	1.67	13.00	3.96	6.56	2.00	4	Digiclops
8.60	2.62	6.37	1.94	14.00	4.27	6.56	2.00	4	Digiclops
9.80	2.99	7.27	2.21	15.00	4.57	6.56	2.00	4	Digiclops

Tilting the Camera

The camera may be tilted in order to avoid imaging objects such as walls, or to alter the coverage area. One thing to be aware of when tilting the camera is that occlusion can become an issue. When the camera is looking straight down, occlusion can occur near the edges of the image, but is reduced as one moves closer to the centre of the image. However, as the tilt angle of a camera increases, there is a corresponding increase in the opportunity for a person to be fully occluded from view throughout the entire image.

Using More Than One Camera

Additional stereo cameras are typically used in order to increase the field of view; they can also be used to deal with occlusion problems. The increased field of view comes at the expense of decreased system throughput due to the additional stereo processing that needs to be done. Censys3D™ currently supports the use of up to four cameras. When using additional cameras, it is important to calibrate their position/orientation with respect to one another so that the 3-D data can be integrated properly. One way to do this is to use [Multiclops™](#), which can be downloaded from PGR's website.

1.4. Additional Downloads and Support

Access more PGR Technical Application Notes on the web at:

www.ptgrey.com/support/downloads

Point Grey Research Inc. endeavors to provide the highest level of technical support possible to our customers. Most support resources can be accessed through the Product Support section of our website: www.ptgrey.com/support.

Creating a Customer Login Account

The first step in accessing our technical support resources is to obtain a Customer Login Account. This requires a valid name, e-mail address, and camera serial number. To apply for a Customer Login Account go to www.ptgrey.com/support/downloads/.

Knowledge Base

Our on-line knowledge base at www.ptgrey.com/support/kb/ contains answers to some of the most common support questions. It is constantly updated, expanded, and refined to ensure that our customers have access to the latest information.

Product Downloads

Customers with a Customer Login Account can access the latest software and firmware for their cameras from our downloads site at www.ptgrey.com/support/downloads. We encourage our customers to keep their software and firmware up-to-date by downloading and installing the latest versions.

Contacting Technical Support

Before contacting Technical Support, have you:

1. *Read the product documentation and user manual?*
2. *Searched the Knowledge Base?*
3. *Downloaded and installed the latest version of software and/or firmware?*

If you have done all the above and still can't find an answer to your question, contact our Technical Support team at www.ptgrey.com/support/contact/.