Autonomous Vehicles Research Studio

Setup Guide – Optitrack Camera Hardware

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A. Mounting Cameras

The **Autonomous Vehicles Research Studio** standard configurations include the Optitrack Flex 13 (Figure 1) camera solution. The number of vehicles involved directly affects the number of cameras required, the required minimum size of the room, and the corresponding approximate size of the volume captured by the cameras (Table 1).

Vehicles	1-4	4-7	7-10
Cameras	6	8	12
Minimum Room Size (m) (LxWxH)	4.5 x 4.5 x 2.5	6.0 x 6.0 x 2.5	7.0 x 7.0 x 2.5
Corresponding Workspace (m) (LxWxH)	3.5 x 3.5 x 2.0	5.0 x 5.0 x 2.0	6.0 x 6.0 x 2.0

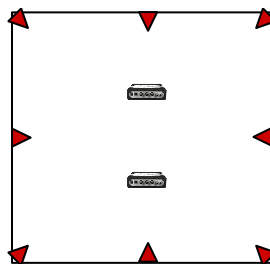Table 1: Recommended room and workspace sizes
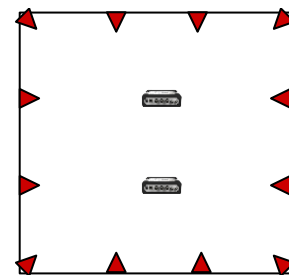
Figure 1: the Flex 13 camera

Based on the number of cameras required, it is recommended that they be mounted in the room as depicted in Figure 2. As the room size increases, or if a greater capture volume is required, more cameras can be installed. Make sure to install them inside the netting so they are not covered by nets to have a clear view of the workspace.
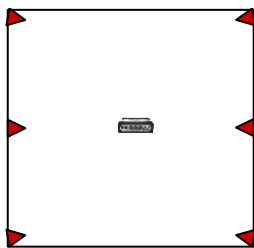
a. 6 camera configuration   b. 8 camera configuration   c. 12 camera configuration

Figure 2. Camera mounting configuration (top view, not to scale)

> **Note**: At this time, also consider mounting options for the OptiHubs (also shown in Figure 2), which will be covered in the section on OptiHubs below.

The camera mounts/clamps provided with the Autonomous Vehicles Research Studio can be used to secure the cameras (Figure 3):
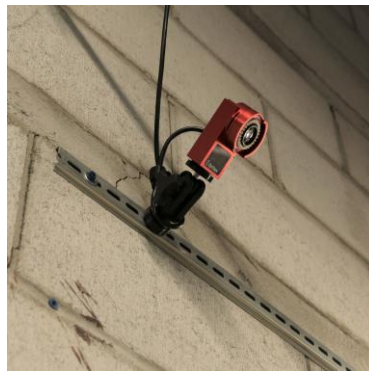
1. I-beams: the camera mounts can be clamped directly to the beams (Figure 3a).
2. Concrete wall: A wooden block or aluminum bar (not included) can be attached to the wall and cameras mounted to the block/bar using clamps. (Figure 3b)
3. False ceilings: The camera clamps can be attached to the false ceiling T-bars directly. In case the camera height needs to be lowered, an extension rod (not included) can be used (Figure 3c).

Note: Please contact Quanser technical support (tech@quanser.com) for more information about this.

Note: Exact orientation of the cameras will be adjusted in Step 9 – Orienting Cameras section later in this document
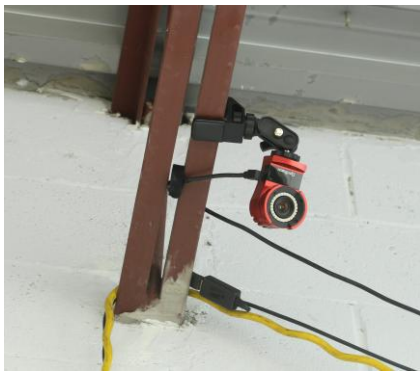
a. Direct mounting on I beams   b. Metal strip on concrete   c. False ceiling extension

Figure 3. Mounting cameras on ceiling/wall

B. OptiHubs

Once the cameras are mounted in locations suitable for the application, the cameras should be connected directly to the USB ports on the OptiHub (Figure 4a). Next, power up the OptiHub by connecting the supplied power supply (Figure 4b) to the power port (Figure 4c). Then connect the OptiHub to the PC using the USB port next to the power connector (Figure 4b). A single OptiHub can be used to sync the feed of up to 6 Flex 13 cameras.
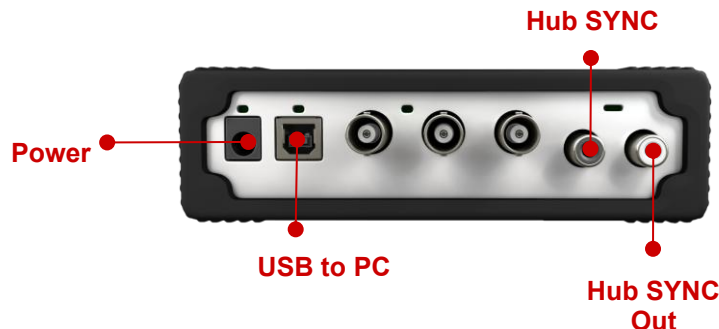
> **Note**: OptiTrack cameras must be connected directly to the OptiHub **with the supplied cables**. USB extensions must not be used between a camera and the OptiHub. However, a maximum of 2 active USB extension cables can be used to connect the OptiHub to a PC.

USB to Flex

a. USB connections for Flex 13 cameras

b. OptiHub power supply



Hub SYNC

Power

USB to PC

Hub SYNC Out

c. Power and Sync connections

Figure 4: OptiHub connections

If using 8 or 12 cameras, at least 2 OptiHubs are required. In this case, use the sync cable to connect the Hub SYNC In port from one of the hubs to the Hub SYNC Out port on another (Figure 5c). In this case, both the OptiHubs must be connected to the PC via USB ports. For more detailed information, please refer to Supplementary Material/OptiHub Quick Start Guide or to the online website for OptiTrack resources (https://docs.optitrack.com/quick-start-guides/quick-start-guide-getting-started). These connections are also illustrated in Figure 8a for 6 cameras and Figure 5b for 8/12 cameras.
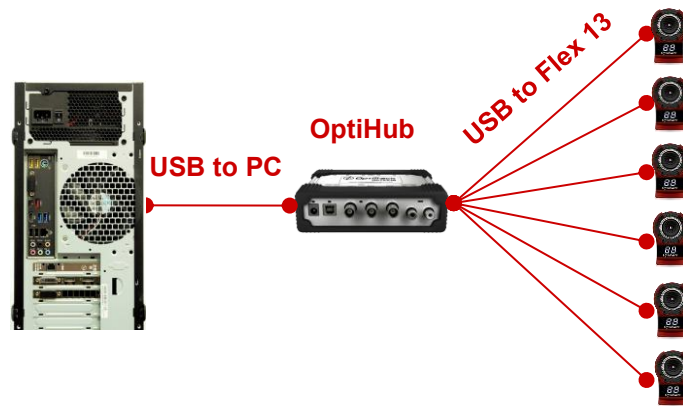
a. 6 cameras with a single OptiHub
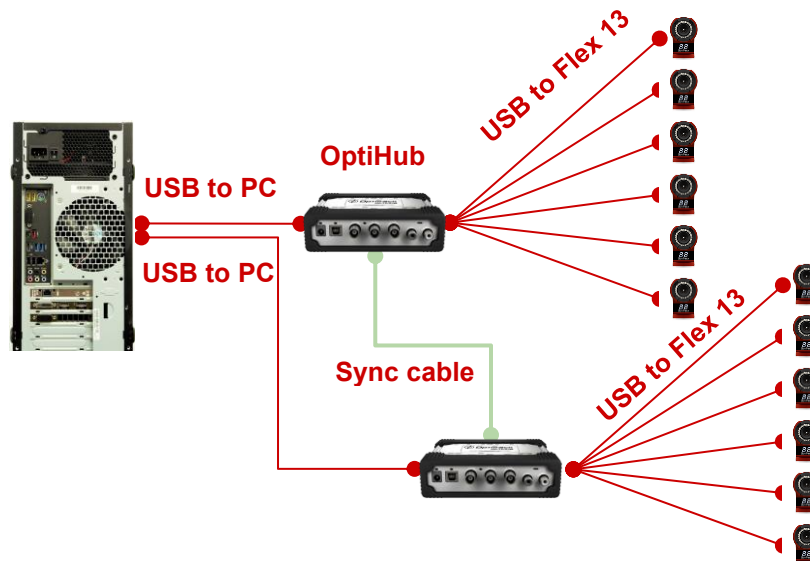
b. 8/12 cameras with a single OptiHub (in case of 8, remove any 4 cameras)

Figure 5: Wiring 6/8/12 Flex 13 cameras to the PC via OptiHub(s)

C. Other Camera Solutions

Table 1 summarizes the standard room/workspace configurations for the **Autonomous Vehicles Research Studio** when using the Flex 13 cameras. In the case of different configurations, non-Flex 13 camera solutions can also be used. In particular, the OptiTrack Prime series cameras (Figure 6) are supported, wherein, a gigabit Ethernet camera switch is required instead of an OptiHub. The wiring procedure is similar to the case with the Flex 13 cameras and the OptiHub, but ethernet cables are used instead of USB cables. The Ethernet camera switch requires an additional network card, which will be provided with the PC (see Step 4 – pc setup).

| a. PrimeX 13 | b. PrimeX 13W | c. PrimeX 22 | d. PrimeX 41 |

Figure 6: Optitrack Prime camera series

The number and type of the Prime cameras used will determine which gigabit Ethernet camera switch is needed. This is summarized in Table 2 below (detailed information at Optitrack Accessories - Sync and Networking which is found on the website (https://optitrack.com/accessories/sync-networking/).

> **Note**: Do NOT use the Ethernet switch for any other purpose than to provide communications with the cameras due to bandwidth considerations

> **Note**: Do NOT mix up the router & switches - two separate ethernet ports are provided on the PC for each of them.

Camera Type	Power required per camera (W)	Number of cameras to be used		
		6	8	12
PrimeX 13	15.4	TN	NG	NG
PrimeX 13W	15.4	TN	NG	NG
PrimeX 22	34.2	NG	NG	NG
PrimeX 41	34.2	NG	NG	NG
TN	TRENDnet TPE-TG80G - 123 W			
NG	NETGEAR ProSafe GS728TPP - 384 W			

Table 2: Prime camera support with different camera switch

D. Checkpoint – Localization System Picture

Take a picture of your localization system setup to confirm with a Quanser engineer or technical support specialist (tech@quanser.com) that the workspace is properly configured.

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