Ex1 Computer Vision 3D

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1. The term “accidental” images refers to a phenomenon in which light passes through a passage, and then projects the scene that emitted it onto a surface. As the name suggests this is done without intending.
   The first type is an ‘Accidental pinhole camera image’:
   The image is created when the light passing through a hole projects an inverted image of the outside world onto a surface opposite the hole.
   This can happen not only within the camera, but also in our daily environment, for example if a window is mostly closed and the room is relatively dark we can see the same pinhole effect and see the scene outside the window projected onto the wall opposite of it.
   The second type is an “inverse” pinhole camera image:
   It is formed by subtracting an image with a small occluder (something that blocks the light) from another similar image without the occluder: this creates in the place of the occluder, by doing that we can see the image the occluder hides.
   This can happen ‘accidentally’ also by capturing 2 images of a window, one with an occluder and the second one without, and subtracting them.
2. Inverse pinhole camera is a way of retrieving an image using a subtraction of 2 almost identical images, but in one of the images there is a small occluder that blocks some of the light.
   It can be done for example by taking 2 frames of the same scene from a video, one with occlusion and the second without, and subtracting them to get the occluded image.
   By subtracting you get: $I_{window}(x) - I_{occluded-window}(x) = T_{hole}(x) * S(x)$ or in other words, The occluded image. The limitations of such a method is that you need 2 images or a video, and also the signal per noise ratio is bad because of the use of 2 images, and the conditions are never exactly the same
3. Here we can see a good example of a **pinhole camera**, the pinhole is a slightly opened window, and we can slightly see the scene of the outside of the window projected onto the wall in front of it.

4. The pinhole camera is based on the principle that light travels in straight lines, and that by controlling the path of light through a small hole (the smaller it is the sharpest the image that we get), an image can be projected.
   The formalism from the paper goes as follows:
   $S(x) = the\ original\ scene\ that\ is\ projected\ into\ an\ image$
   $T(x) = shape\ of\ the\ pinhole,\ such\ that\ if\ T(x) = 0\ the\ light\ doesn't\ pass\ if\ T(x) = 1$
   $then\ all\ the\ light\ passes$
   $I(x) = the\ actual\ image\ that\ formes$: $I(x) = S(x) * T(x)$
   Were ' $*$ ' means a convolution.
   We can use this knowledge for example to retrieve the shape of the window that let the light in, in an image, without seeing it directly in the image:
   (this is done by assuming the window opening is small, from the course 'waves and optics' in physics')

   $I(x) = S(x) * T(x)$ in the paper
   F is the fourier transform
   $\Rightarrow F[I(x)] = F[S(x) * T(x)] = F[S(x)]F[T(x)]$ rule of applying a fourier transform over a convolution
   $\Rightarrow \frac{F[I(x)]}{F[S(x)]} = F[T(x)]$
   $\Rightarrow F^{-1}\left[\frac{F[I(x)]}{F[S(x)]}\right] = T(x)$
   were $T(x)$ is the function that represent the window.

   F^{-1} denotes an inverse fourier transform.