Horizontal Frame Centering Algorithm

Evenly spacing multiple frames on a wall can be a challenge. A friend of mine was hanging some picture frames on a wall in his new place, and he asked me to figure out how to frame a certain number of pictures on a wall such that they are all evenly spaced. If the spacing between the edges of the frames and the space between the edge of the outer frames and the wall are all to be equal, it turns out that, in general, the space between the centers of the inner frames is different than the space between the centers of the outer frames and the edges of the wall.

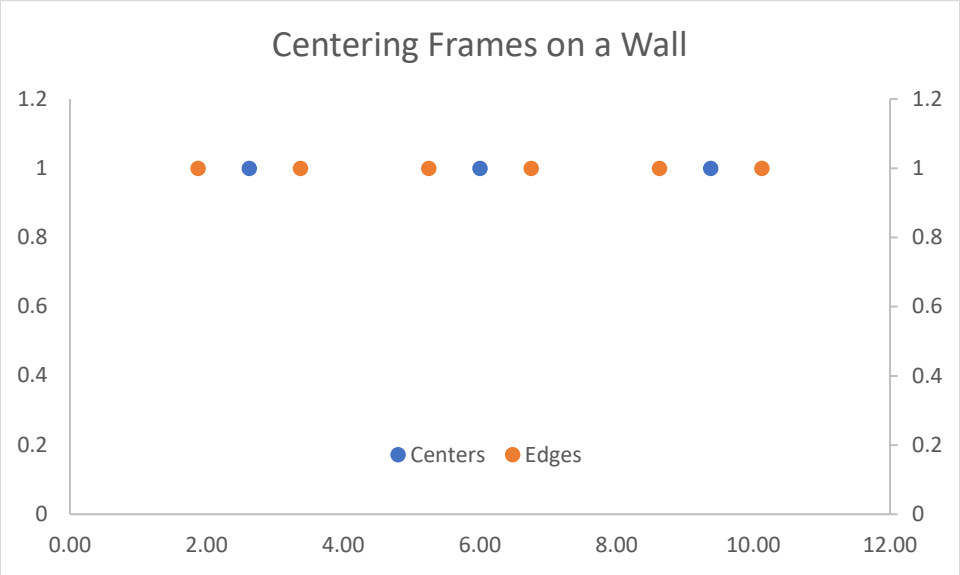

Figure 1: Centering three frames on a wall spanning 12 units.

Note it is assumed the frames all have the same width. The height of the frames is left to the reader.

Considering that the width or span of the wall and the width of the frame can be measured, and the number of picture frames is known, these parameters will be the inputs to the equation. In a way, the number of frames is a control variable while the width of the wall and frames are constraining values or boundary conditions. So,

$$w_{wall} = \text{width of the wall}$$

$$w_{frame} = \text{width of the frame (all same width)}$$

$$n_{frame} = \text{number of frames}$$

From these inputs, the distance between each frame and the distance from the outer frames to the wall's edge should be determinable, however, it is often more convenient to know the location of the center of the frame, so the following values should be determinable using these inputs:

$$d_{edge} = \text{distance between edges of frames}$$

$$d_{wall-to-center} = \text{distance between wall edge and centers of outer frames}$$

$$d_{center-to-center} = \text{distance between centers of inner frames}$$

Consider the constraining equation, which can be used to determine the distance between edges:

$$w_{wall} = 2d_{edge} + w_{frame}n_{frame} + d_{edge}(n_{frame} - 1)$$

$$w_{wall} - w_{frame}n_{frame} = (2 + n_{frame} - 1)d_{edge}$$

$$d_{edge} = \frac{w_{wall} - w_{frame}n_{frame}}{n_{frame} + 1}$$

This value is not entirely relevant in application, though it is necessary to determine the more relevant distance from the wall's edge to the center of the outer frames and the distance between the centers of the inner frames.

$$d_{wall-to-center} = d_{edge} + \frac{w_{frame}}{2}$$

$$d_{center-to-center} = d_{edge} + w_{frame}$$

Using these calculations, one can now easily measure the distance from the wall's edge to the center of the outer frames and measure the distances between the centers of the inner frames.

These measurements can be confirmed using the following equation:

$$w_{wall} = 2d_{edge} + w_{frame} + d_{center-to-center}(n_{frame} - 1)$$

The following generating equations locate the center or edges of a frame:

$$x_{center_i} = d_{wall-to-center} + d_{center-to-center}\left(n_{frame_i} - 1\right) \text{ for } i = 1, 2, 3\ldots$$

$$x_{edge_i} = \begin{cases} d_{edge} & \text{for } i = 0 \\ x_{edge_{i-1}} + w_{frame} & \text{for } i = 1, 3, 5, \ldots \\ x_{edge_{i-1}} + d_{edge} & \text{for } i = 2, 4, 6, \ldots \end{cases}$$

In its most applicable form:

$$x_{center_i} = \frac{w_{wall} - w_{frame}n_{frame}}{\left(n_{frame} + 1\right)} + \frac{w_{frame}}{2} + \left(\frac{w_{wall} - w_{frame}n_{frame}}{\left(n_{frame} + 1\right)} + w_{frame}\right)\left(n_{frame_i} - 1\right) \text{ for } i = 1, 2, 3\ldots$$

Or, perhaps less obtusely,

$$d_{edge} = \frac{w_{wall} - w_{frame}n_{frame}}{\left(n_{frame} + 1\right)}$$

$$x_{center_i} = d_{edge} + \frac{w_{frame}}{2} + \left(d_{edge} + w_{frame}\right)\left(n_{frame_i} - 1\right) \text{ for } i = 1, 2, 3\ldots$$