HOMER implementation

- Requires torso position *t*
- Upon selection, detach virtual hand from tracker, move v. hand to object position in world CS, and attach object to v. hand (w/out moving object)
- Get physical hand position *h* and distance $d_h = \text{dist}(h, t)$
- Get object position *o* and distance $d_o = \text{dist}(o, t)$

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Like Go-Go, HOMER requires a torso position, because you want to keep the virtual hand on the ray between the user's body (torso) and the physical hand. The problem here is that HOMER moves the virtual hand from the physical hand position to the object upon selection, and it is not guaranteed that the torso, physical hand, and object will all line up at this time. Therefore, in my implementation, I calculate where the virtual hand would be if it were on this ray initially, then calculate the offset to the position of the virtual object, and maintain this offset throughout manipulation.

When an object is selected via ray-casting, you must first detach the virtual hand from the hand tracker. This is due to the fact that if it remained attached but you move the virtual hand model away from the physical hand location, a rotation of the physical hand will cause a rotation and translation of the virtual hand. You then move the virtual hand in the world CS to the position of the selected object, and attach the object to the virtual hand in the scene graph (again, without moving the object in the world CS).

To implement the linear depth mapping, we need to know the initial distance between the torso and the physical hand, and between the torso and the selected object. The ratio d_o/d_h will be the scaling factor.

HOMER implementation (cont.)

- Each frame:
  - Copy hand tracker matrix to v. hand matrix (to set orientation)
  - Get physical hand position h_{curr} and distance: $d_{h\text{-}curr} = dist(h_{curr}, t)$
  - V. hand distance $$d_{vh} = d_{h-curr} \times \left(\frac{d_o}{d_h}\right)$$
  - Normalize torso-hand vector $$th_{curr} = \frac{h_{curr} - t}{\|h_{curr} - t\|}$$
  - V. hand position $vh = t + d_{vh}*(th_{curr})$

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Now, each frame you need to set the position and orientation of the virtual hand. The selected object is attached to the virtual hand, so it will follow along.

Setting the orientation is relatively easy. You can simply copy the transformation matrix for the hand tracker to the virtual hand, so that their orientation matches.

To set the position, we need to know the correct depth and the correct direction. The depth is found by applying the linear mapping to the current physical hand depth. The physical hand distance is simply the distance between it and the torso, and we multiply this by the scale factor d_o/d_h to get the virtual hand distance. We then obtain a normalized vector between the physical hand and the torso, multiply this vector by the v. hand distance, and add the result to the torso position to obtain the virtual hand position.