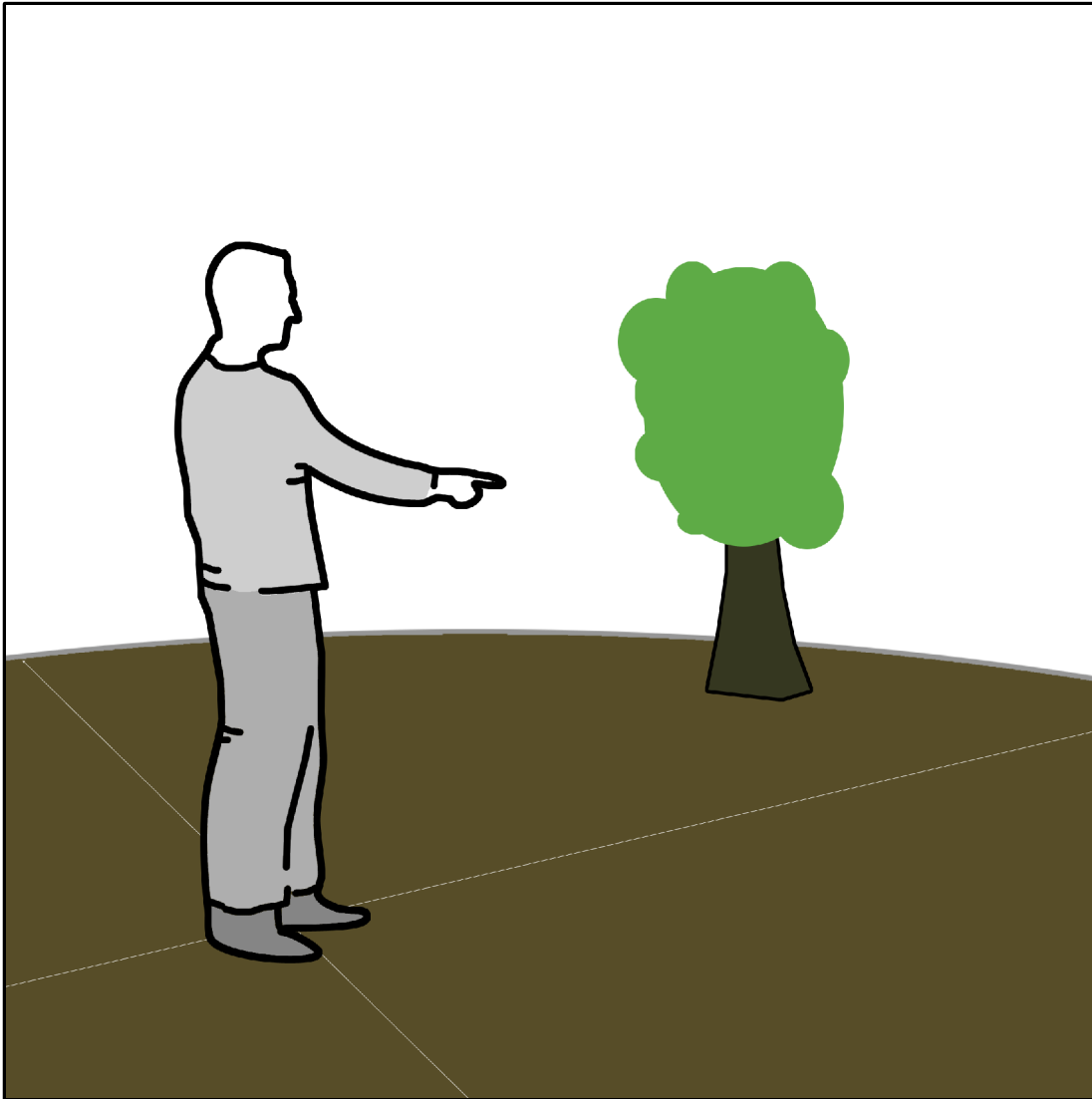


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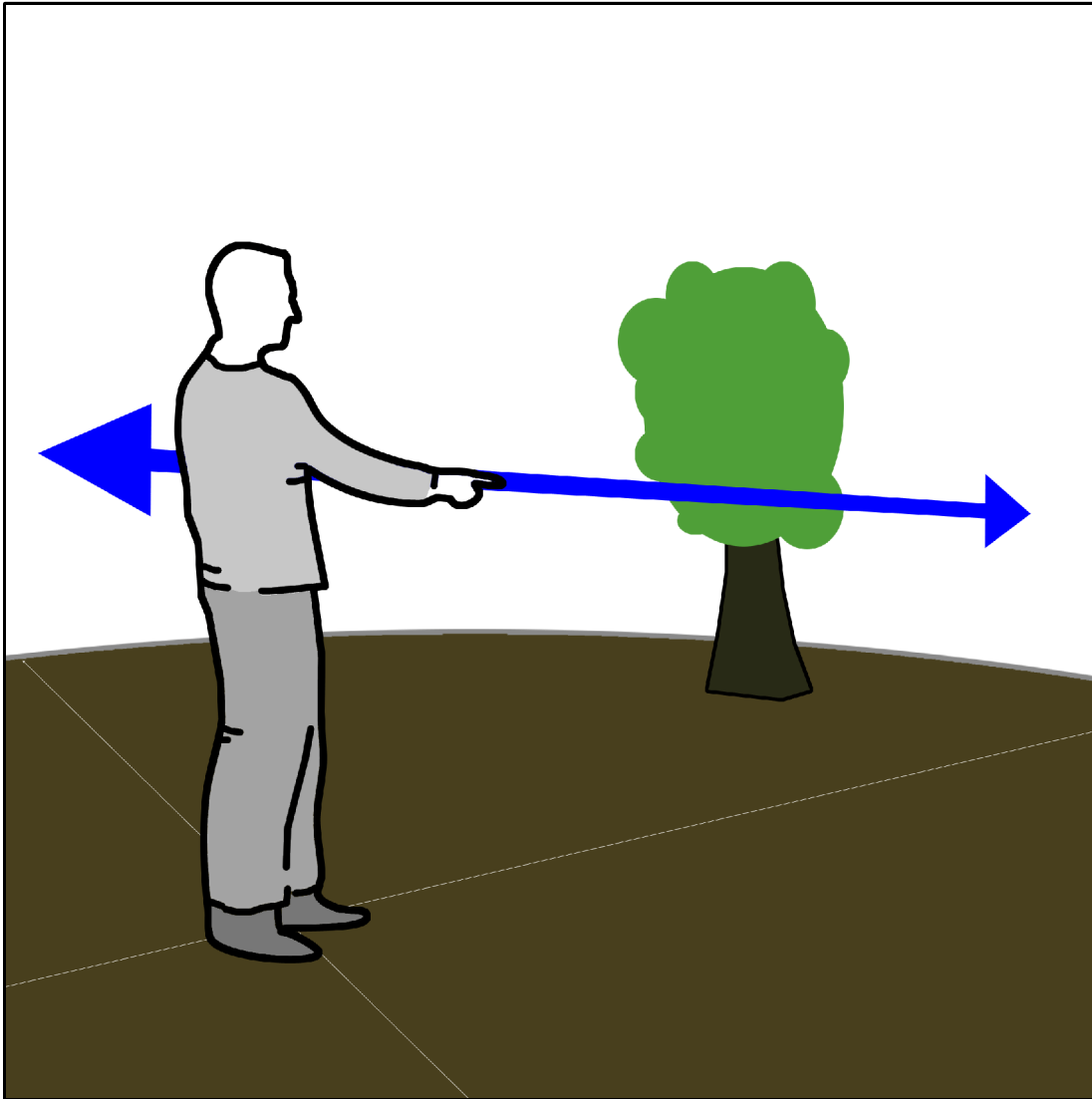




Horizontal spatial  
structure  
(due to gravity)

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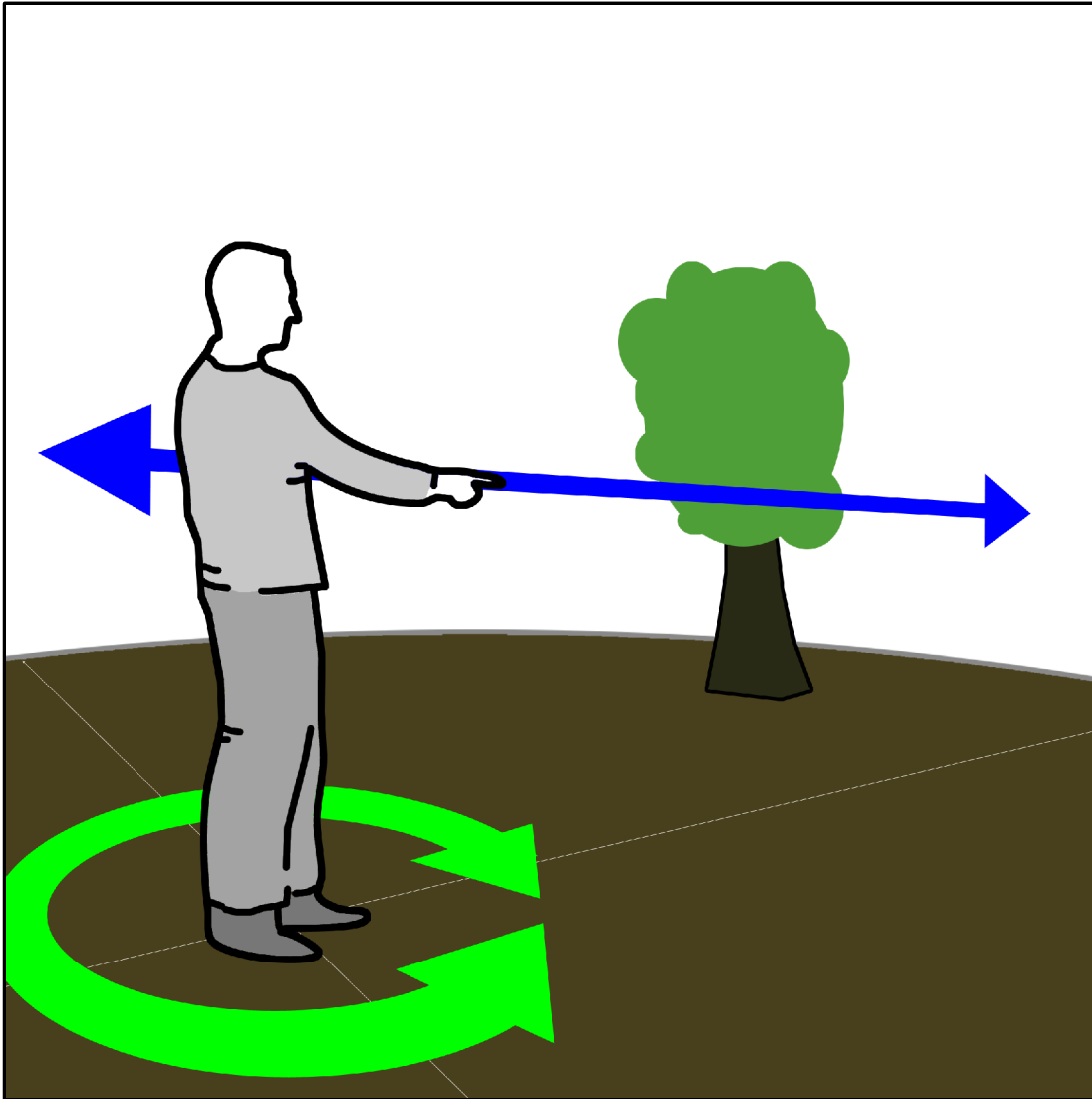


Terrain following navigation is a 2DOF Task.

- Translation along the pointing direction

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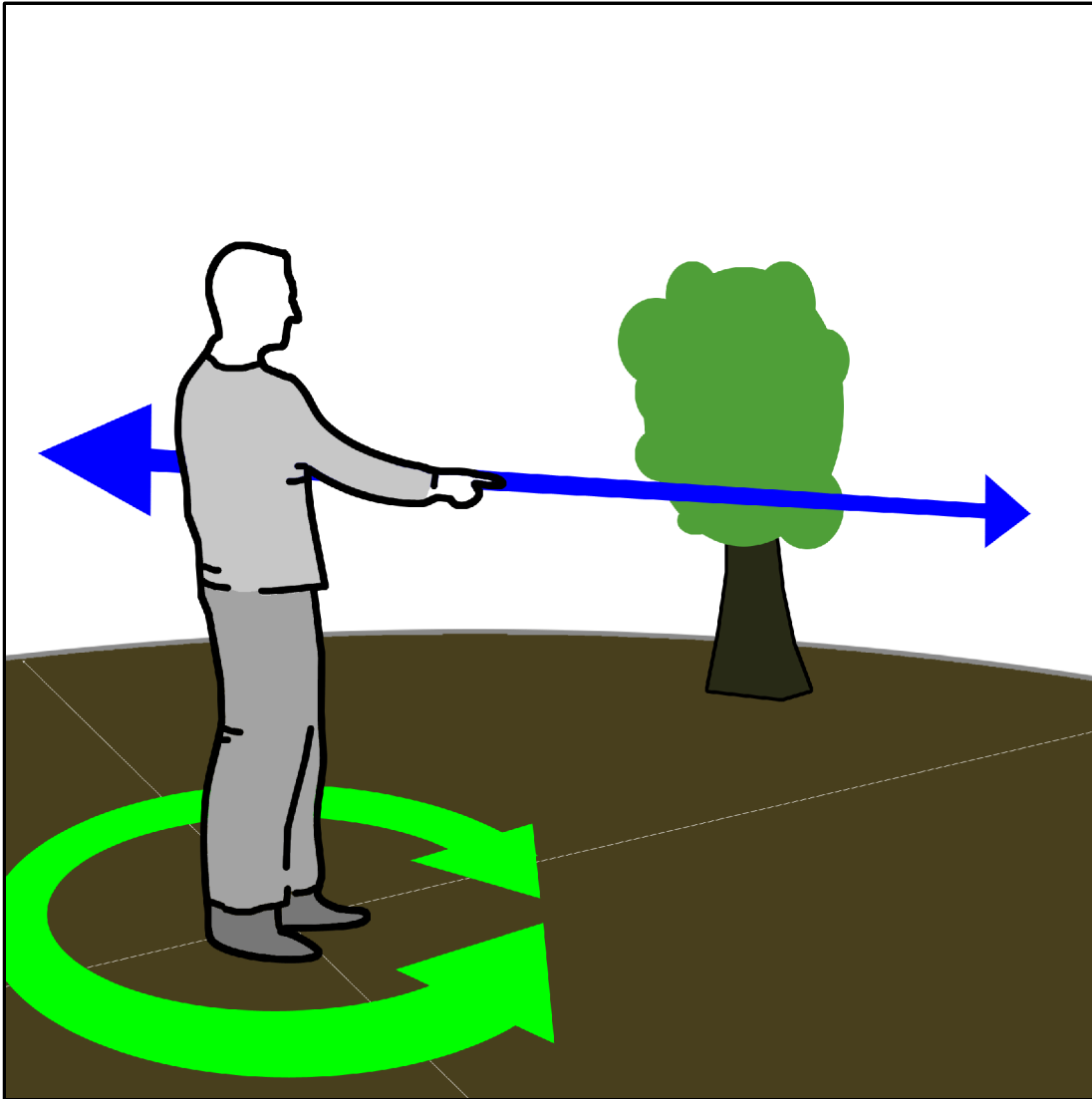


Terrain following navigation is a 2DOF Task.

- Translation along the pointing direction
- Pointing direction (Heading)

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Terrain following navigation is a 2DOF Task.

- Translation along the pointing direction

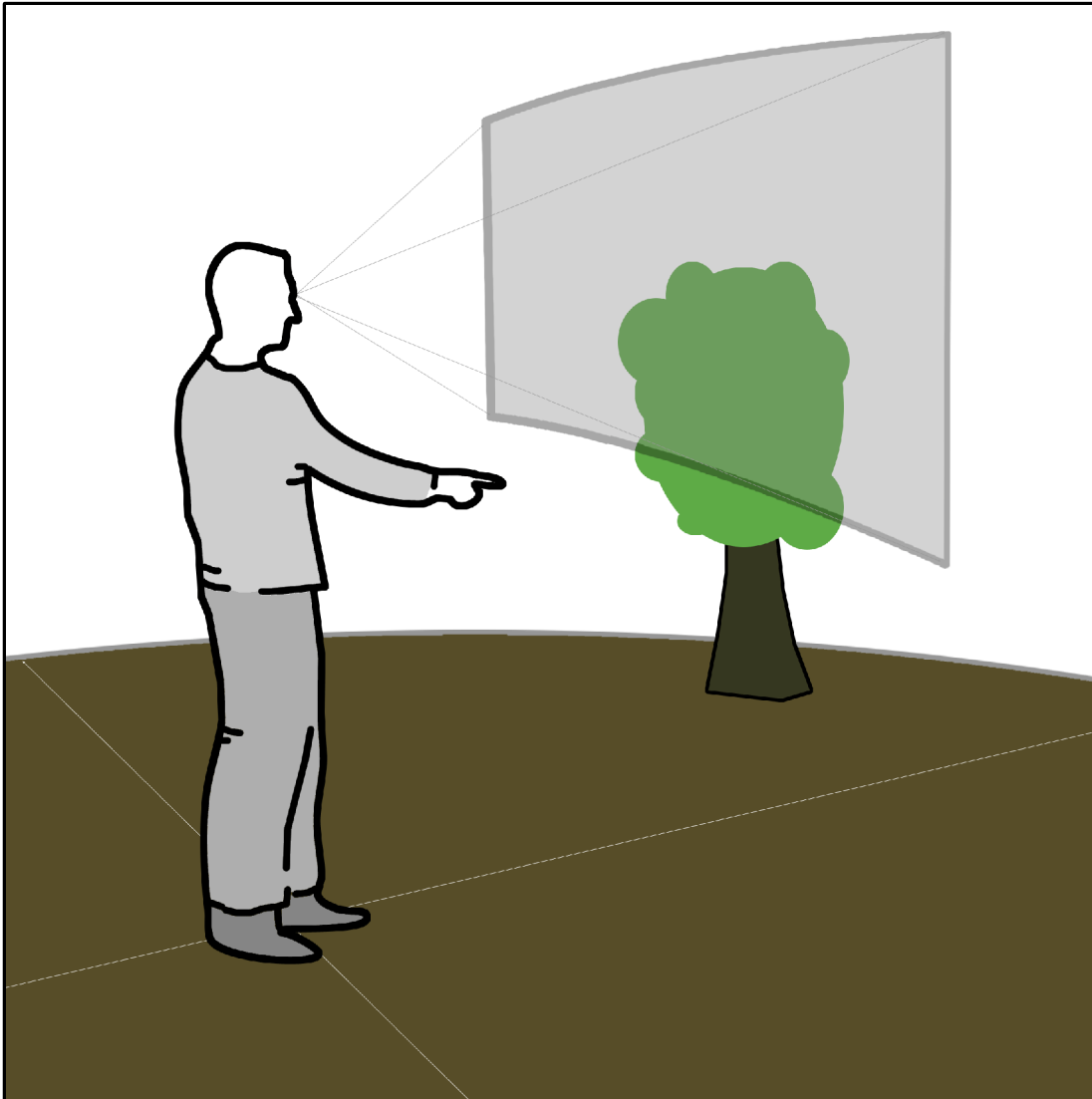
- Pointing direction (Heading)

+ Pitch for free movement

➡ Simultaneously required DOF

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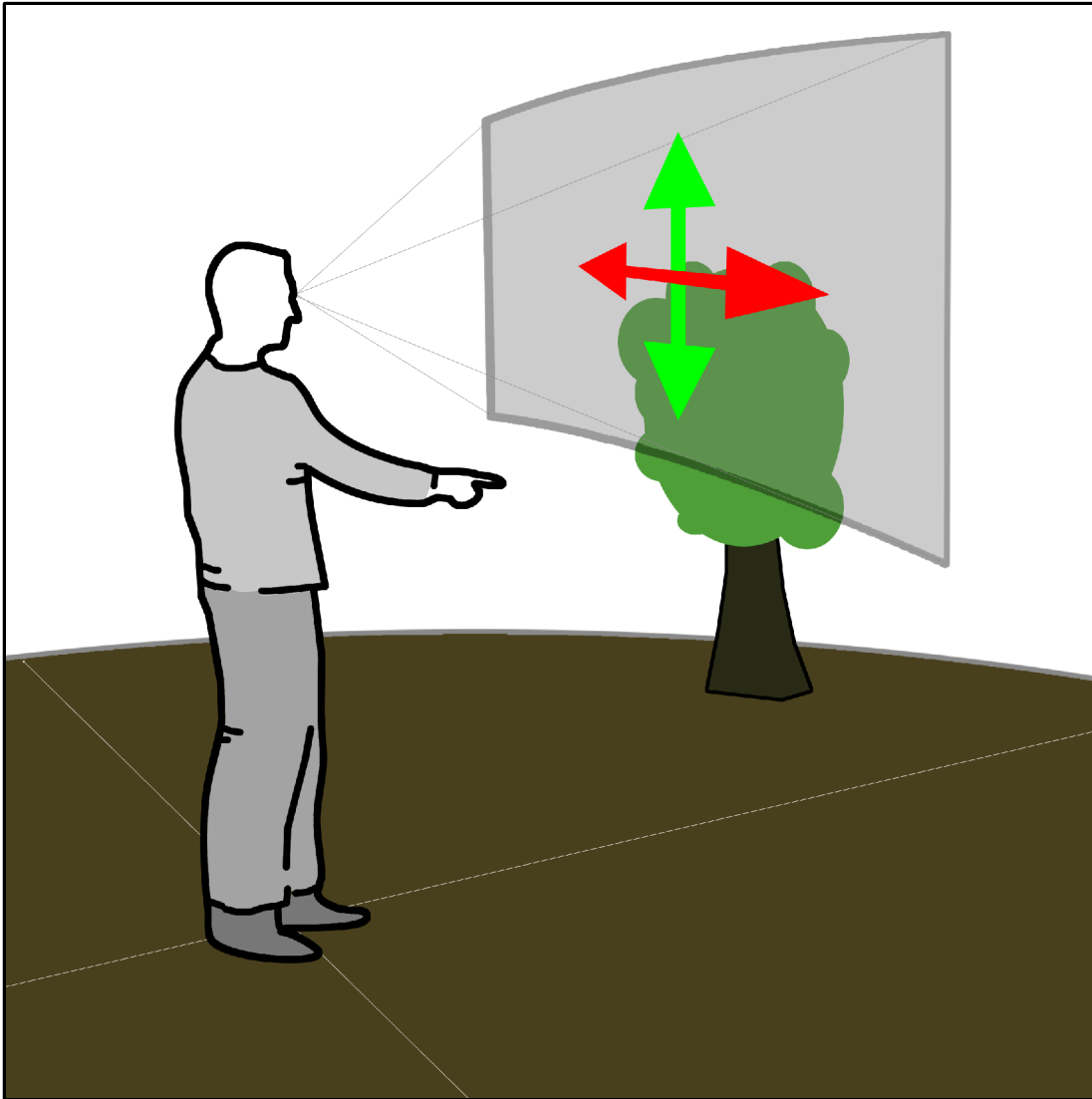




Translation parallel to  
the 2D image plane  
(sliding)

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Translation parallel to  
the 2D image plane  
(sliding)

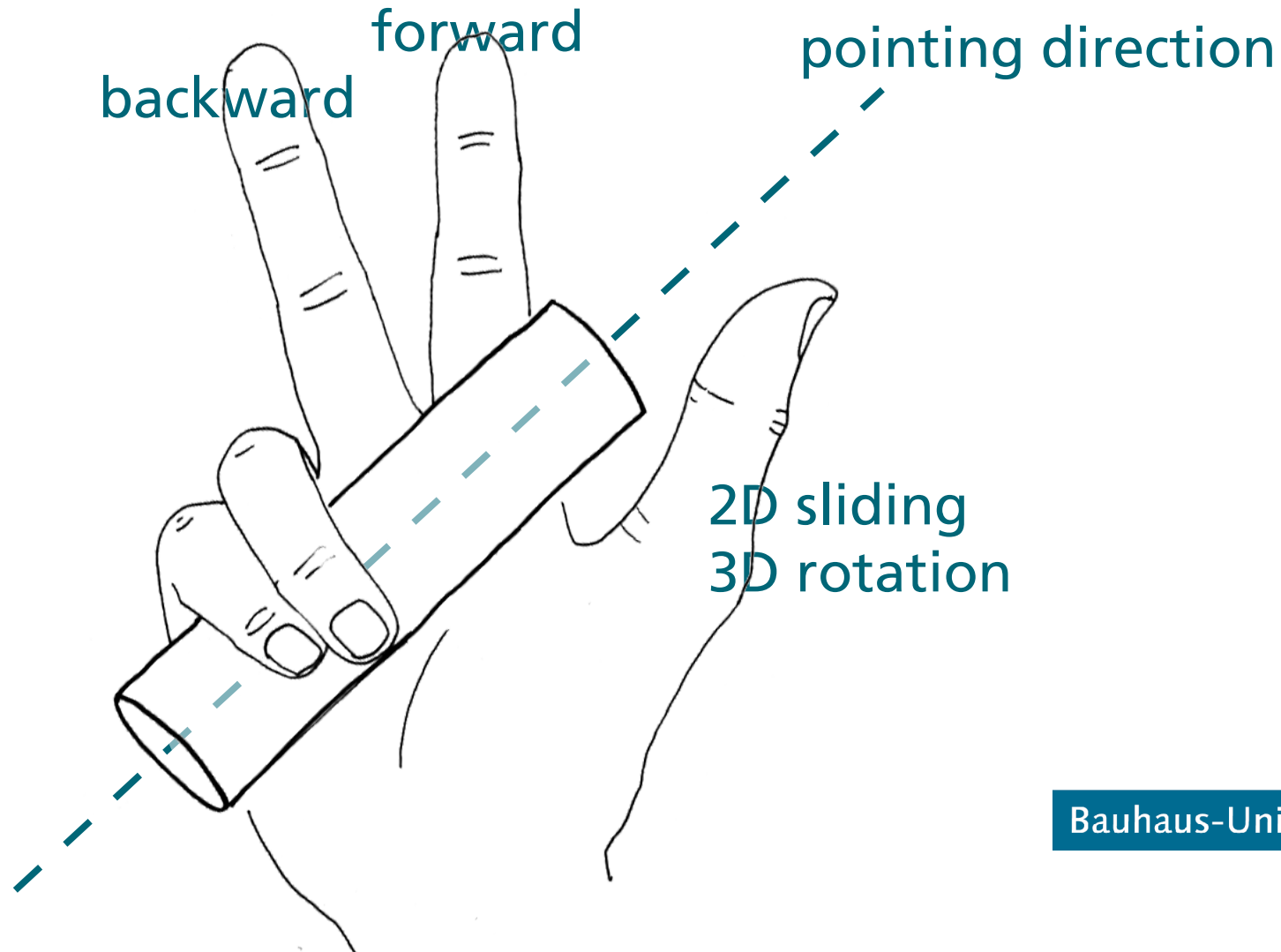
- Vertical axis

- Lateral axis

▶ Simultaneously  
required DOF

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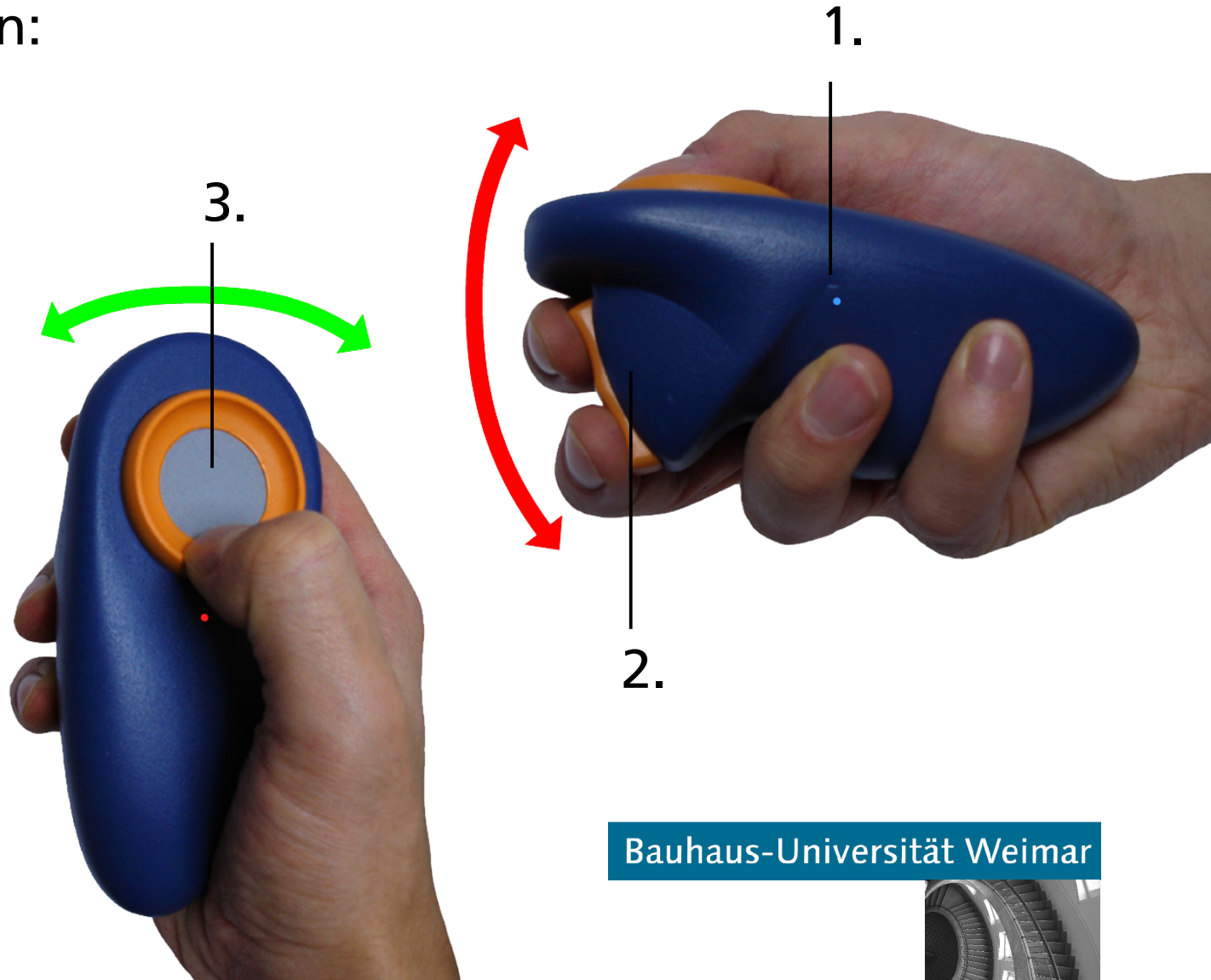
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### Sensor Configuration:

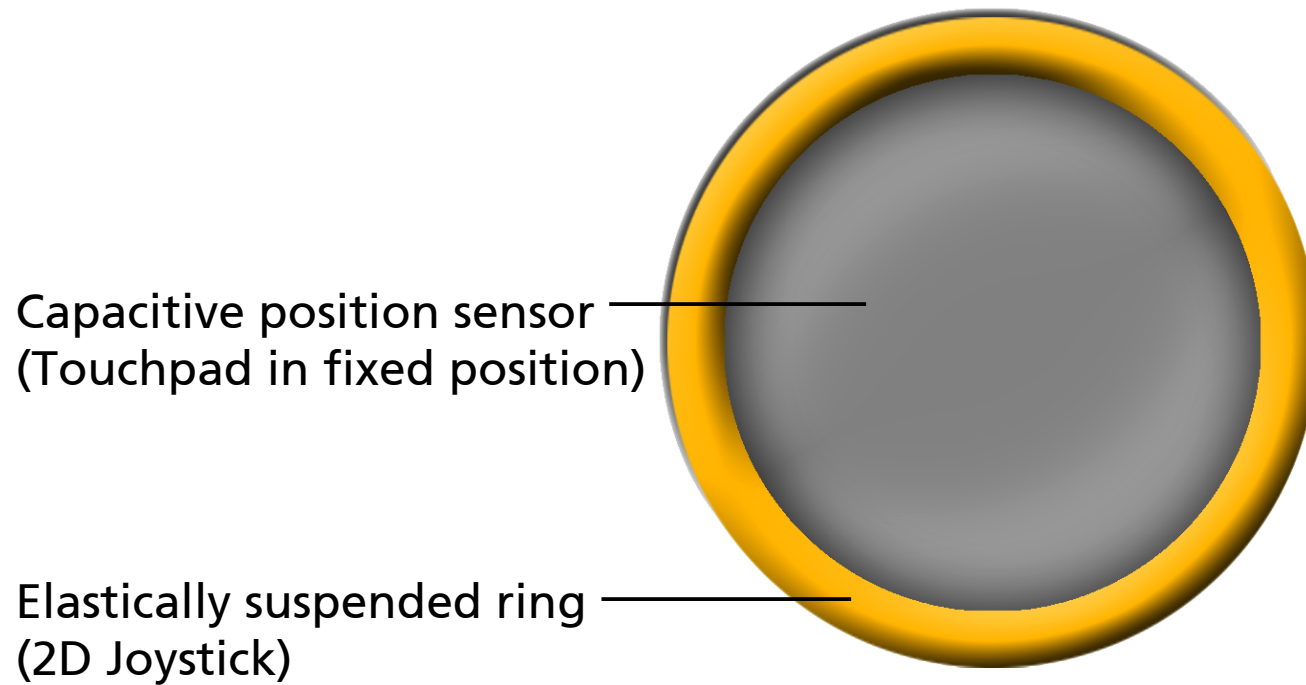
1. Gyroscopic rotation tracker  
- pointing direction
2. Rocker lever  
- forward / backward
3. Groovepad  
- 2D sliding  
- 3D rotation



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### The Groovepad:



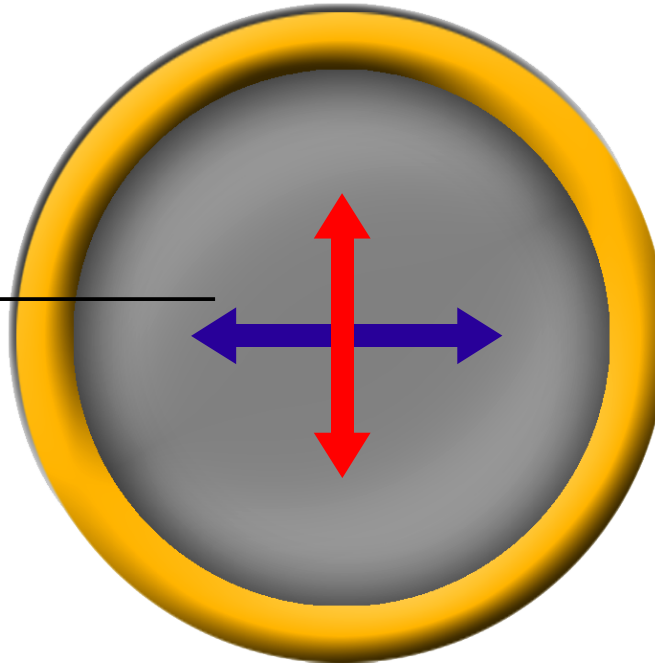
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Thumb gestures on the Groovepad:

### Rotation

Capacitive position sensor  
(Touchpad in fixed position)



Isotonic rotation controller:

- Pitch

- Roll

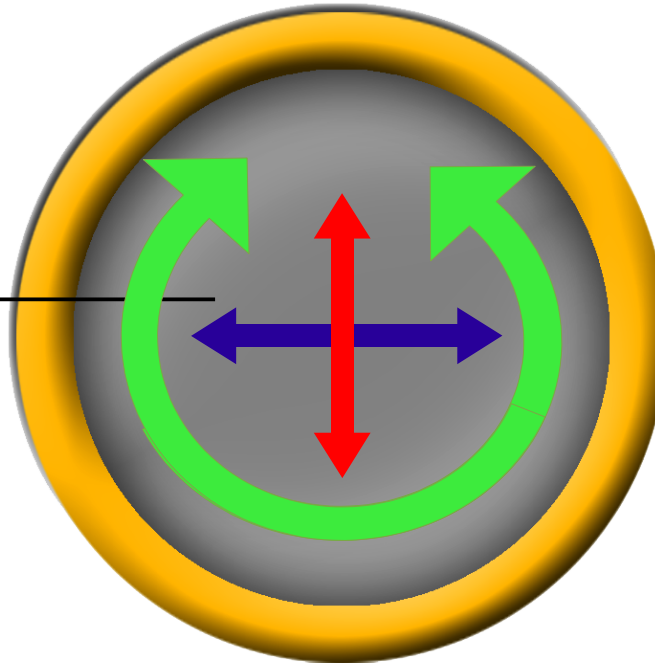
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Thumb gestures on the Groovepad:

### Rotation

Capacitive position sensor  
(Touchpad in fixed position)



Isotonic rotation controller:

- Pitch

- Roll

- Head

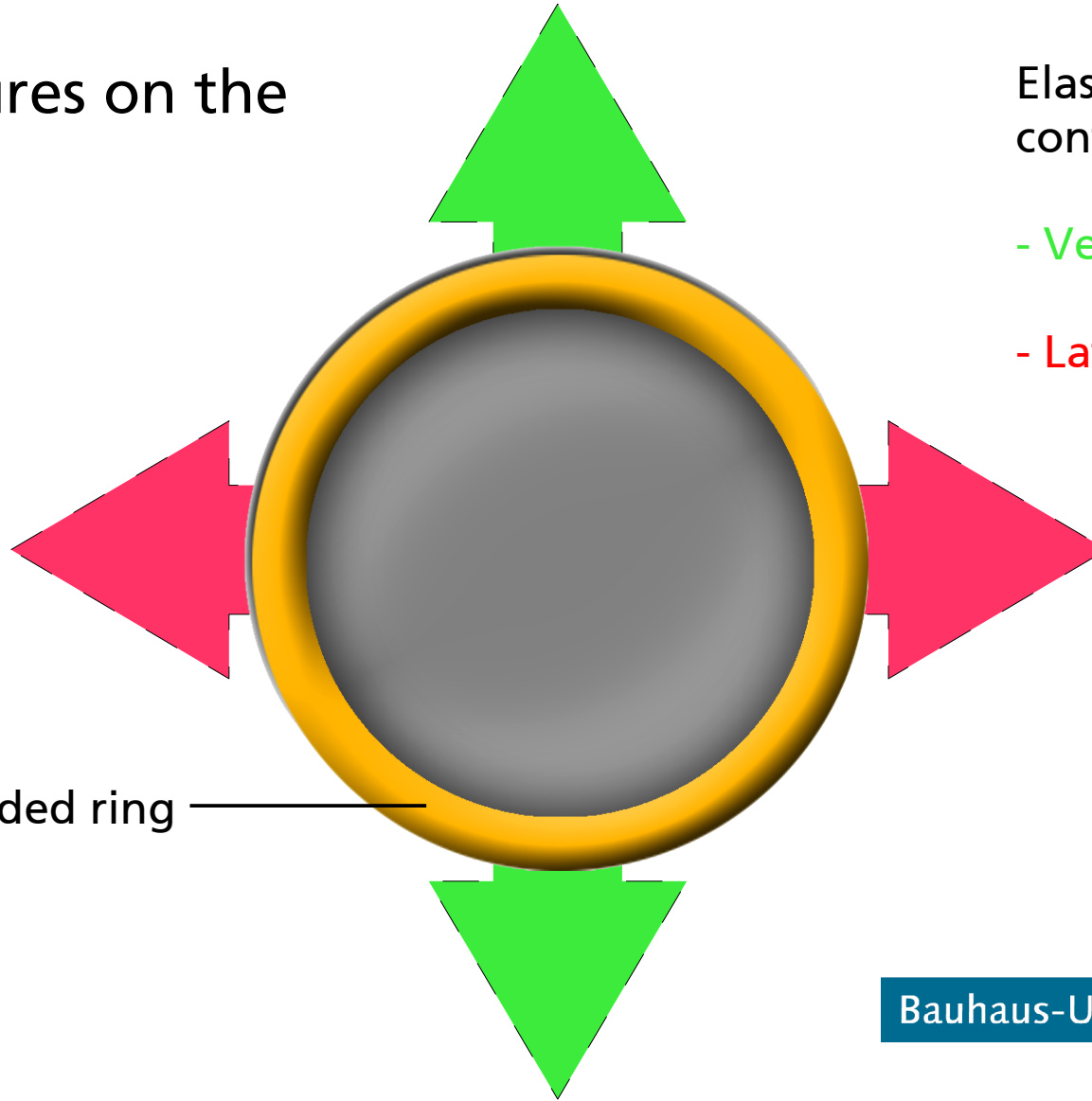
Note: the surrounding ring guides the thumb

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Thumb gestures on the Groovepad:

Translation



Elastical translation controller:

- Vertical axis

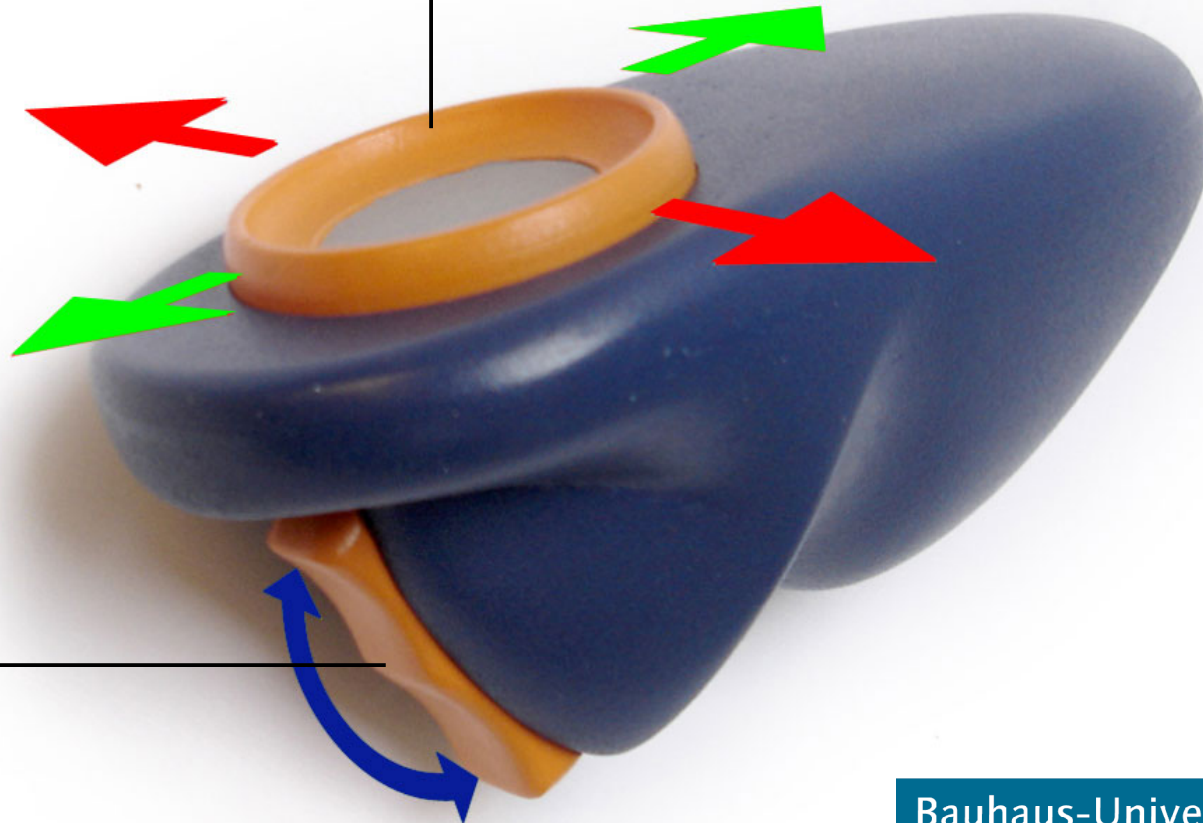
- Lateral axis

Elastically suspended ring (2D Joystick)

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Elastical devices  
- velocity controlled translation



- Vertical axis

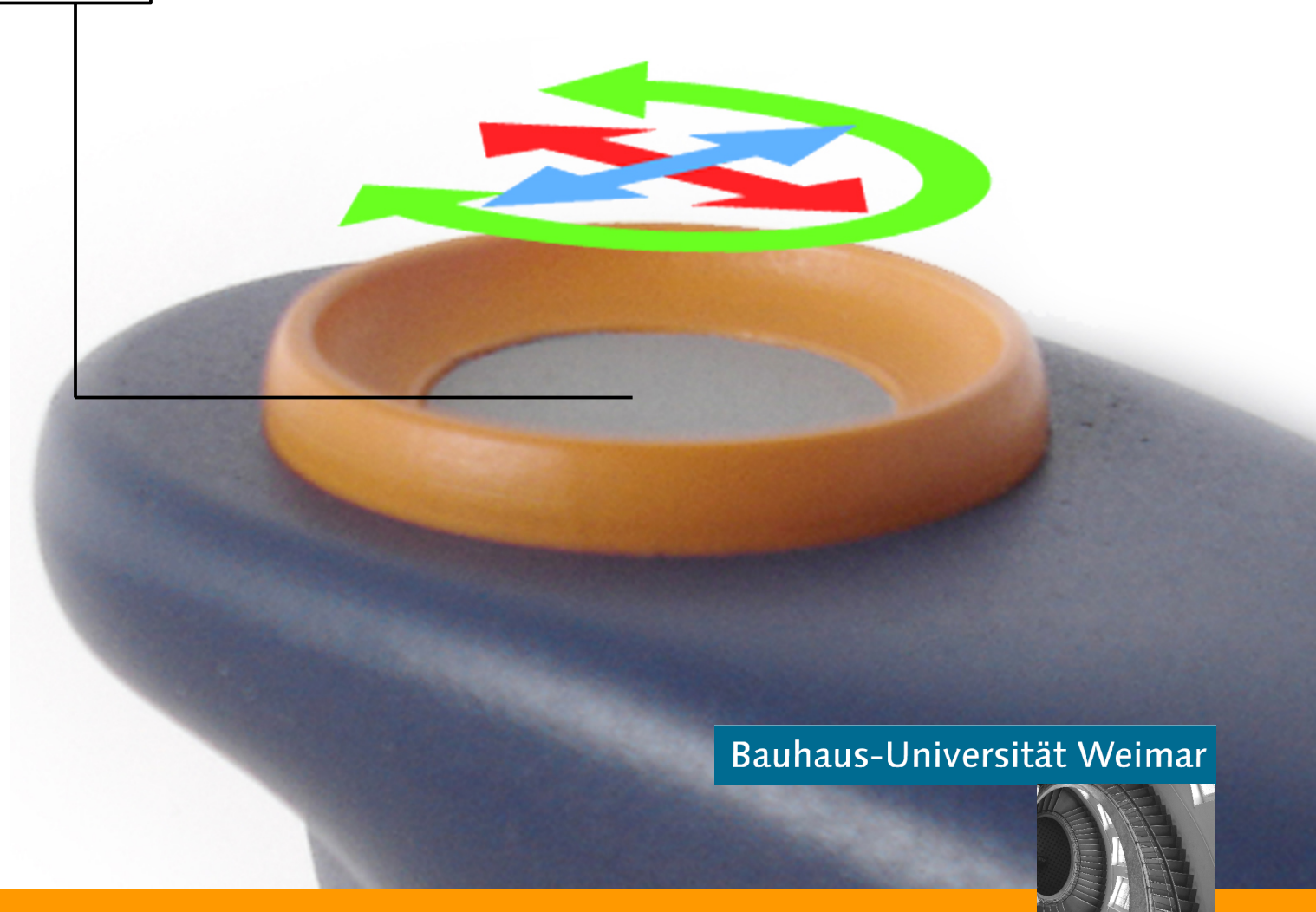
- Lateral axis

- Longitudinal axis

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Isotonic devices  
- position controlled rotation



- Pitch

- Roll

- Head

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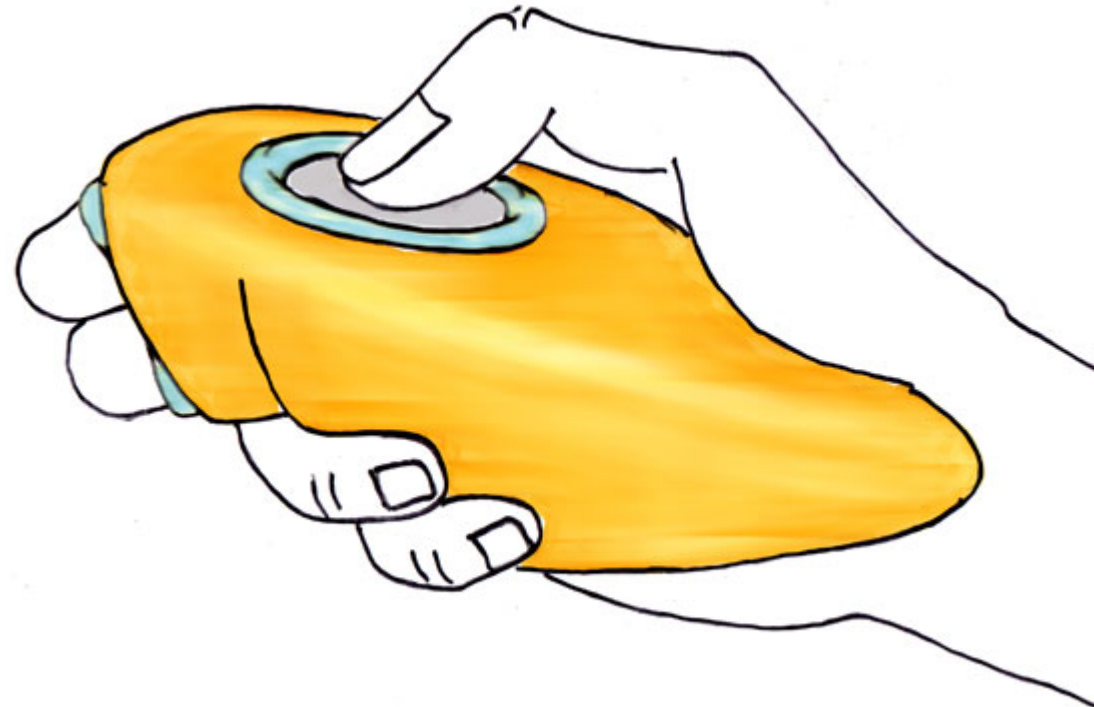
### Conclusions

- Sensor arrangement matches with interaction techniques
- Initial user studies confirm the usability for the designated applications.

### Future work

- Refinements of the hardware design
- Long term user studies

Thank you for your attention!



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