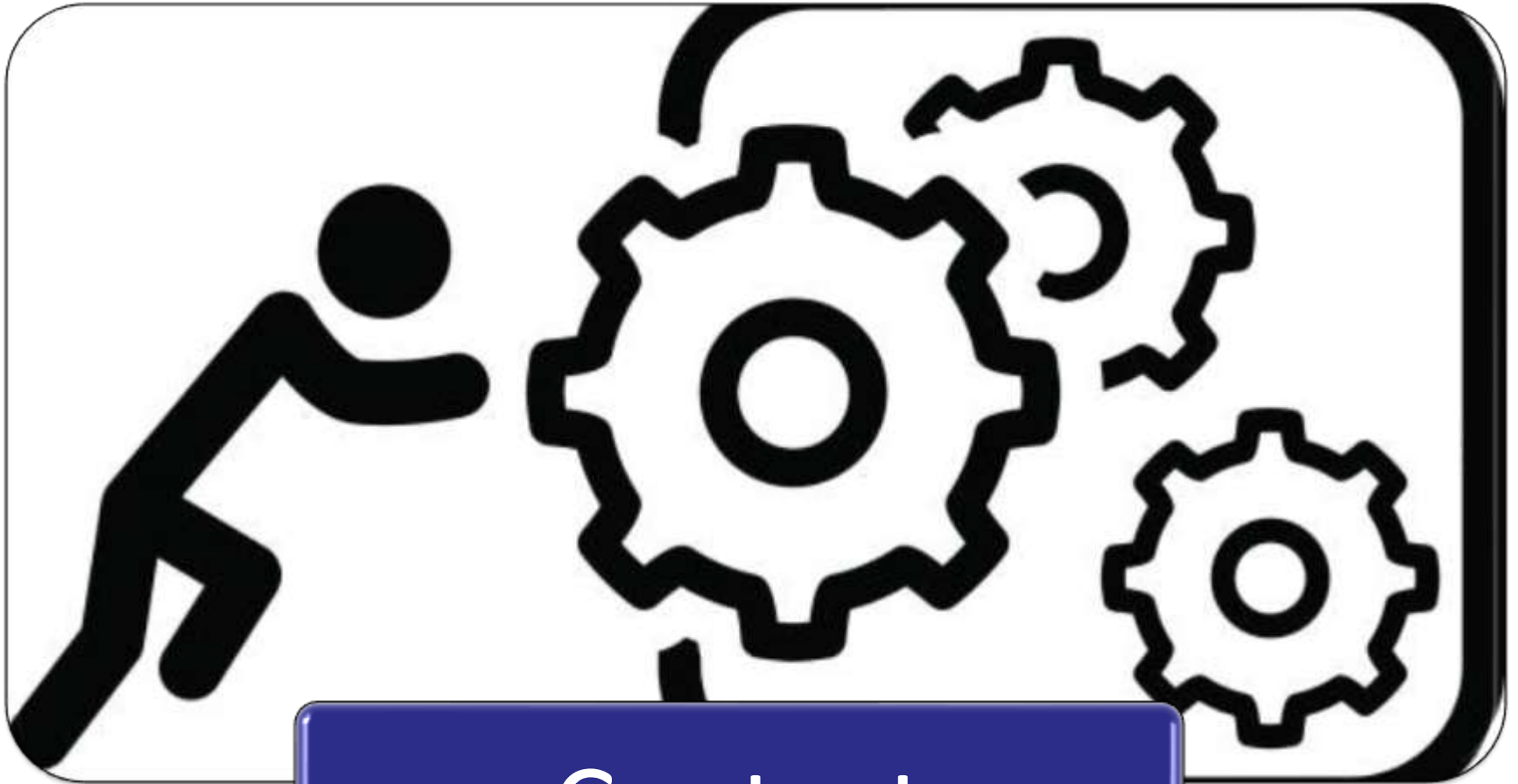
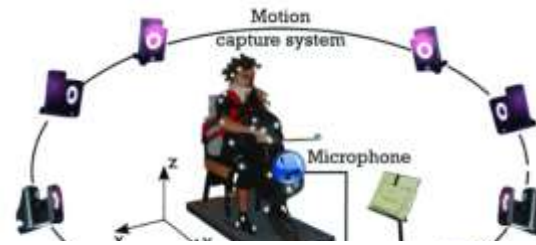


# Developing digital twins of multi-camera metrology systems in Blender

Claire Pottier, Jon Petzing, Fariborz Eghtedari and Peter Kinnell



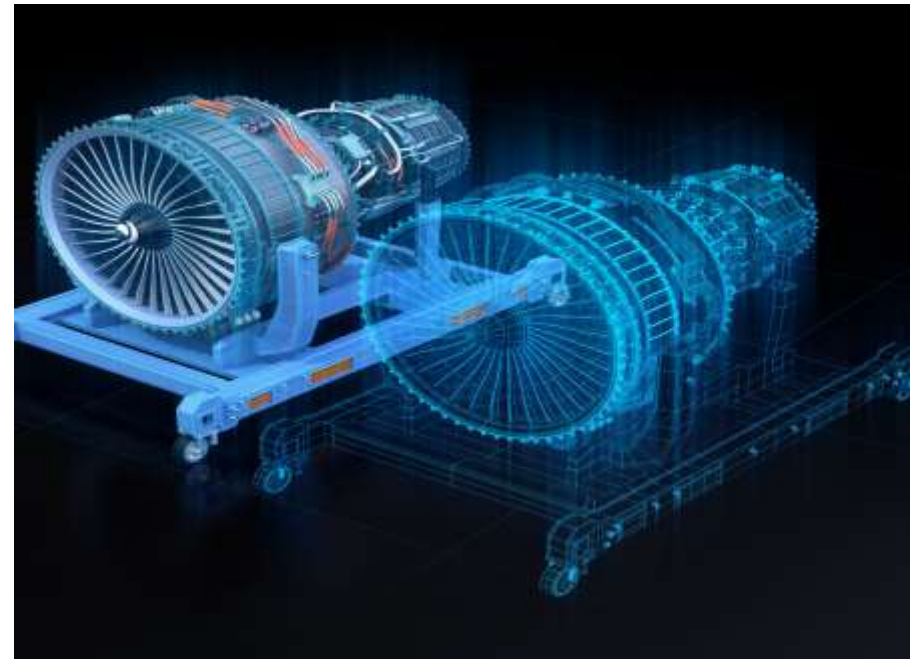
Context



### Drawbacks:

- Markers detections.
- Light of sight.
- Small detection volume, ect.

Optimisation problem  
+  
Connection of the physical and  
virutal spaces  
=  
Digital twin.





Digital twin of a camera

=

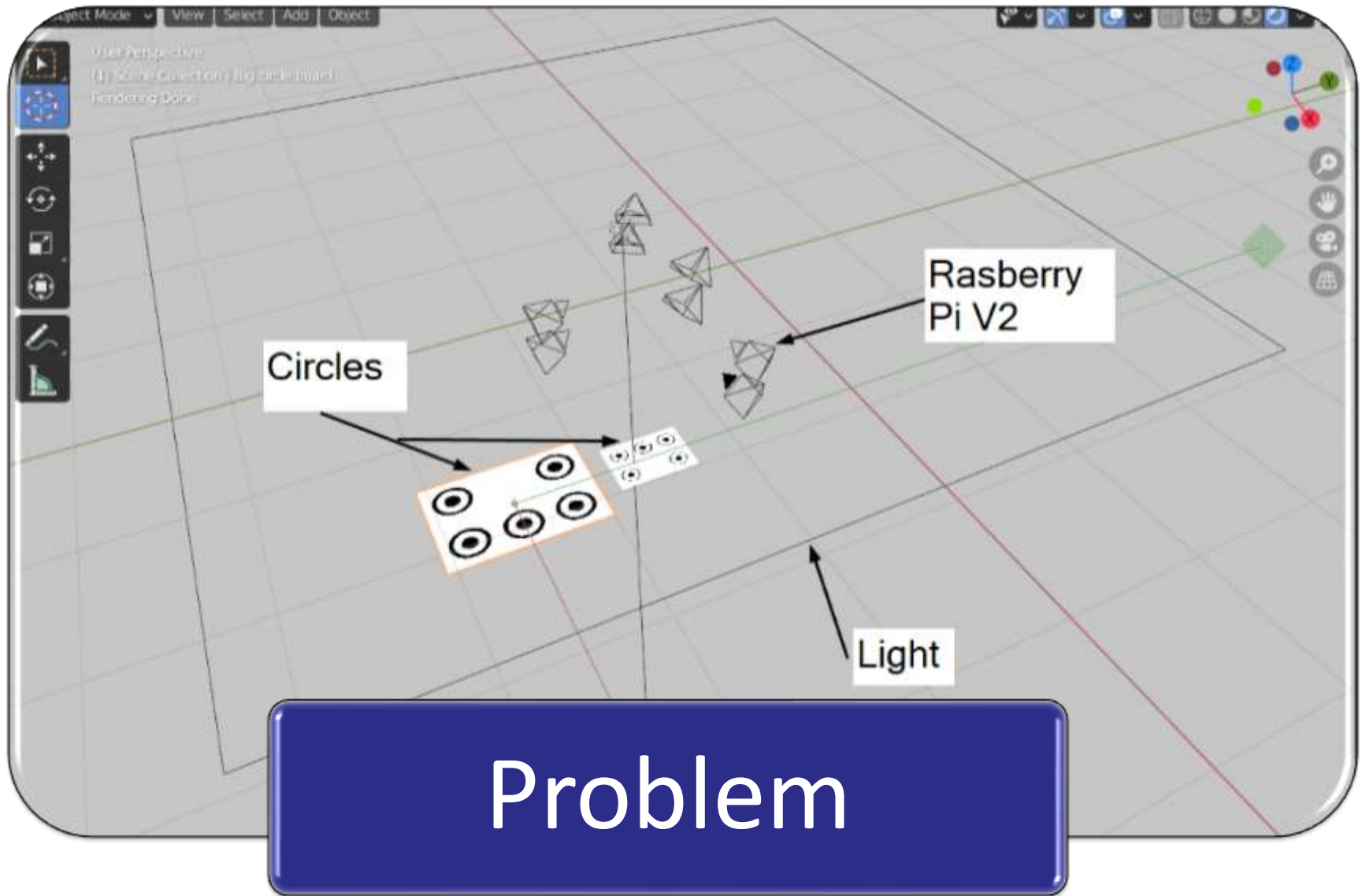
designing the whole camera from the original camera sensor to its radiometric characteristics.



Complex process  
Not necessary accurate  
Time consuming

Alternative: 3D animation software







Better than  
reality

Lack of  
realism

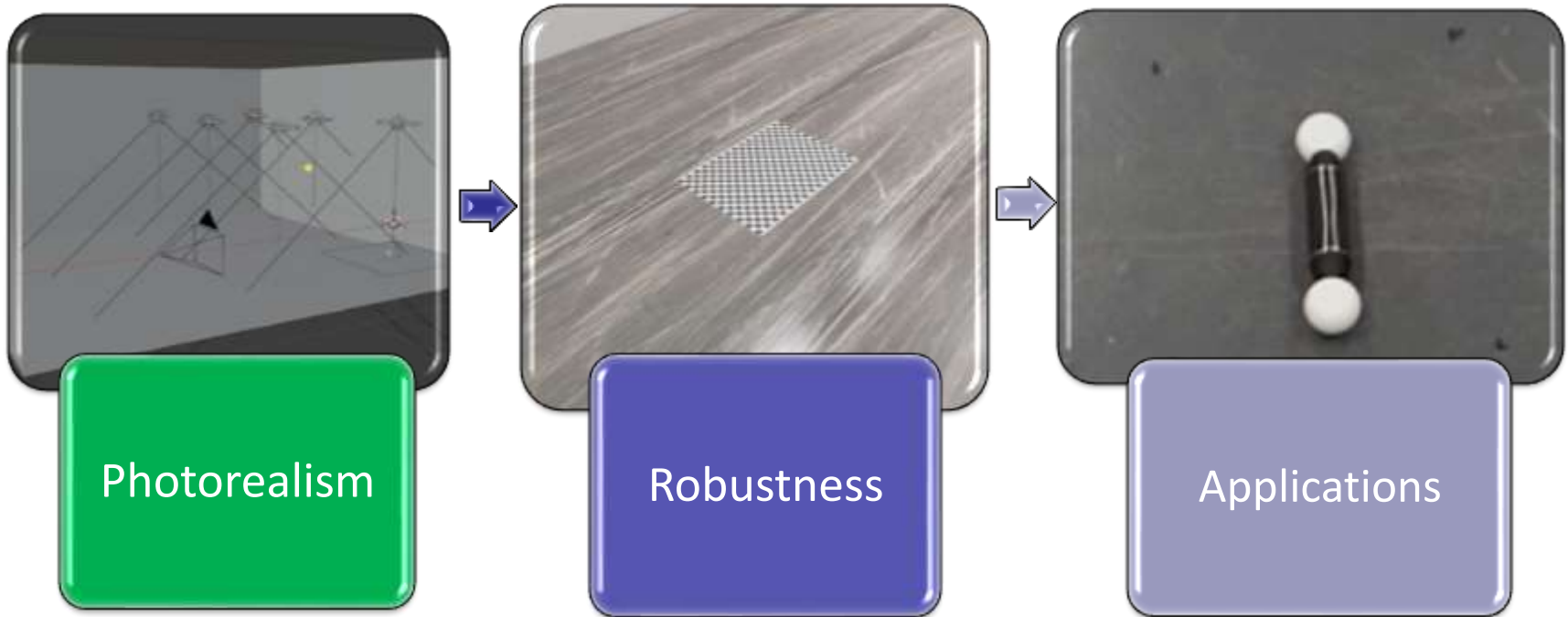
Error  
magnitude:  
cm VS mm

Using  
Blender

Incorrect definition  
of modelling  
boundaries

Light

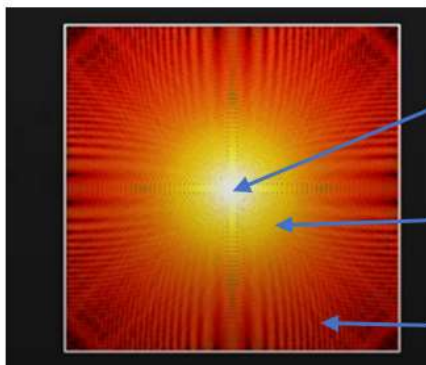
# Solution developed





# Photorealism

Discret Fourier Transform

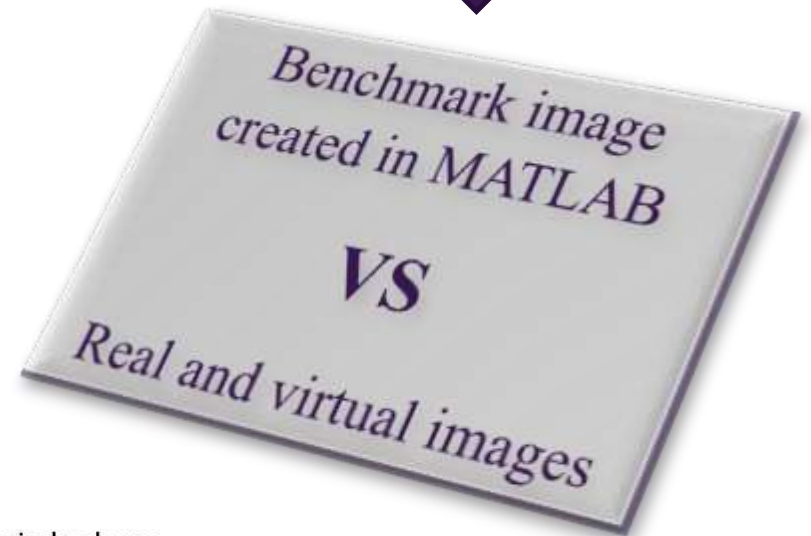


Flat region of the circle, inside the circle shape

Rotationally symmetric Fast Fourier transform.

Edges along any direction that we pick

Percentage of image blur





# Key points

Intrinsically  
different camera,  
behaves as  
filters

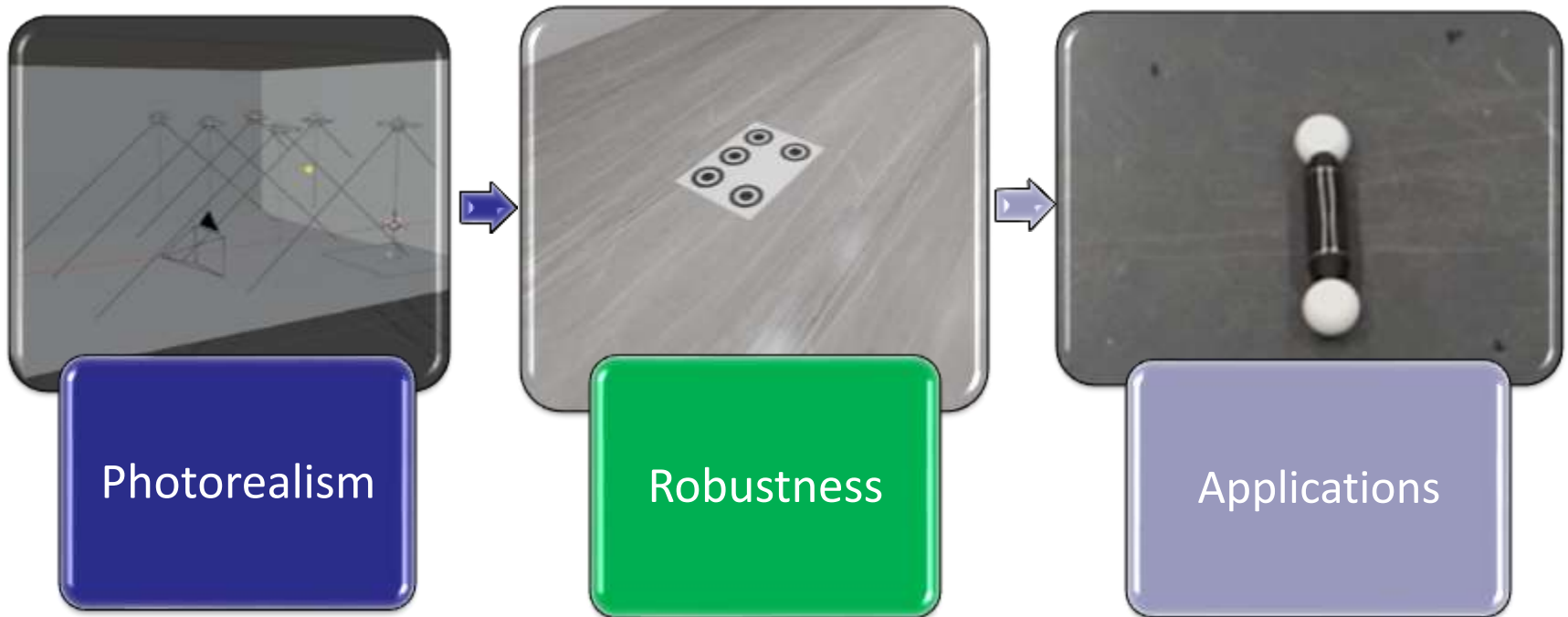
Reach the limits of  
the Human  
understanding and  
the software abilities

Artistically defined  
surface textures,  
not possible to use  
the actual value

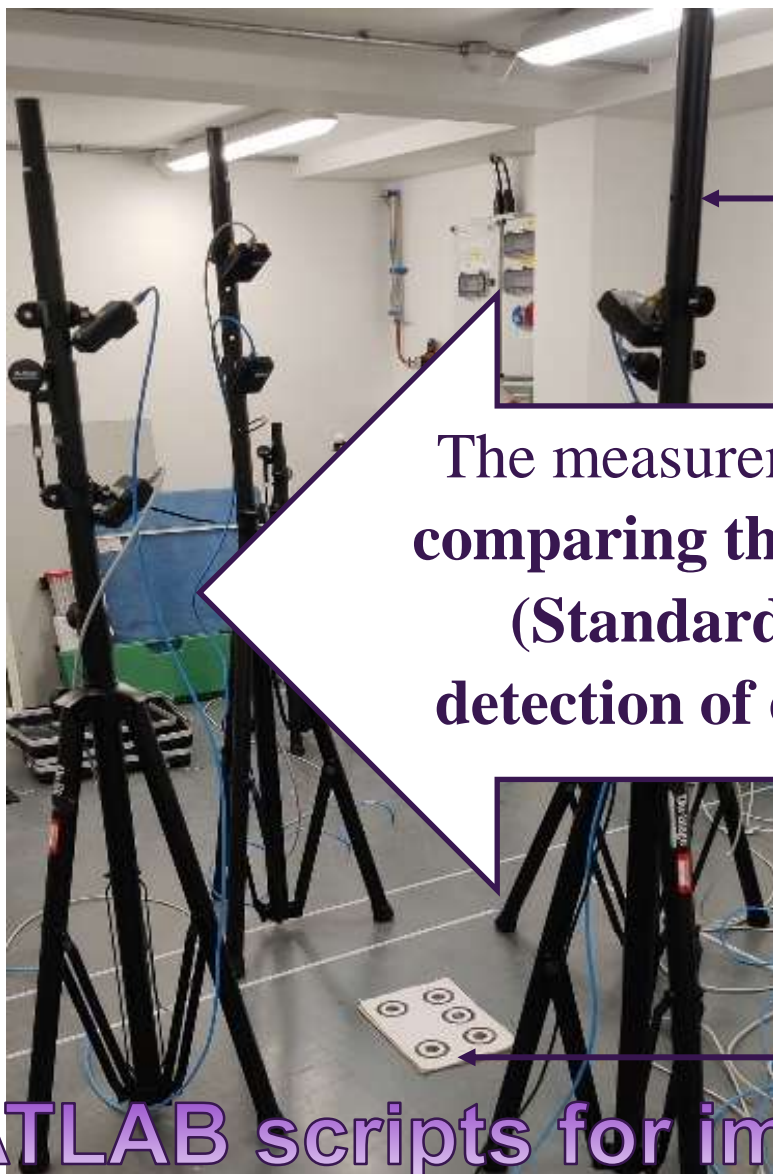
Offset exists  
between the virtual  
and real scenes.



# Table of content



# Blender Camera scene



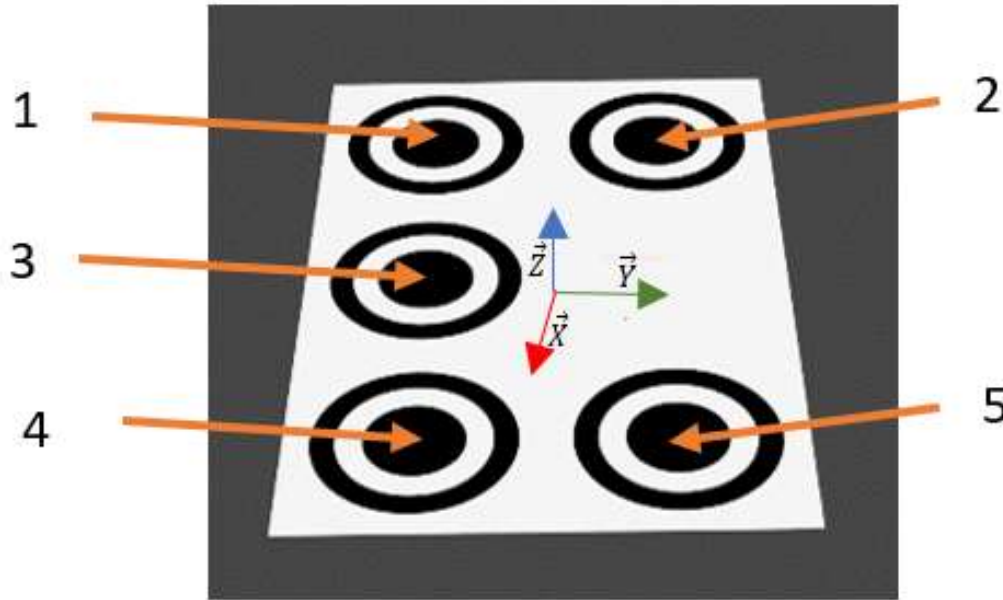
← Tripod

The measurement test consisted of comparing the reprojection errors (Standard deviation) of the detection of calibration artefacts

← Board

**MATLAB** scripts for image treatment

# Artefacts



**Board**

**Dimensions**

**Circle diameters**

Small

0.1 m x 0.15 m x 0.2 m

0.5 m x 0.75 m x 0.025

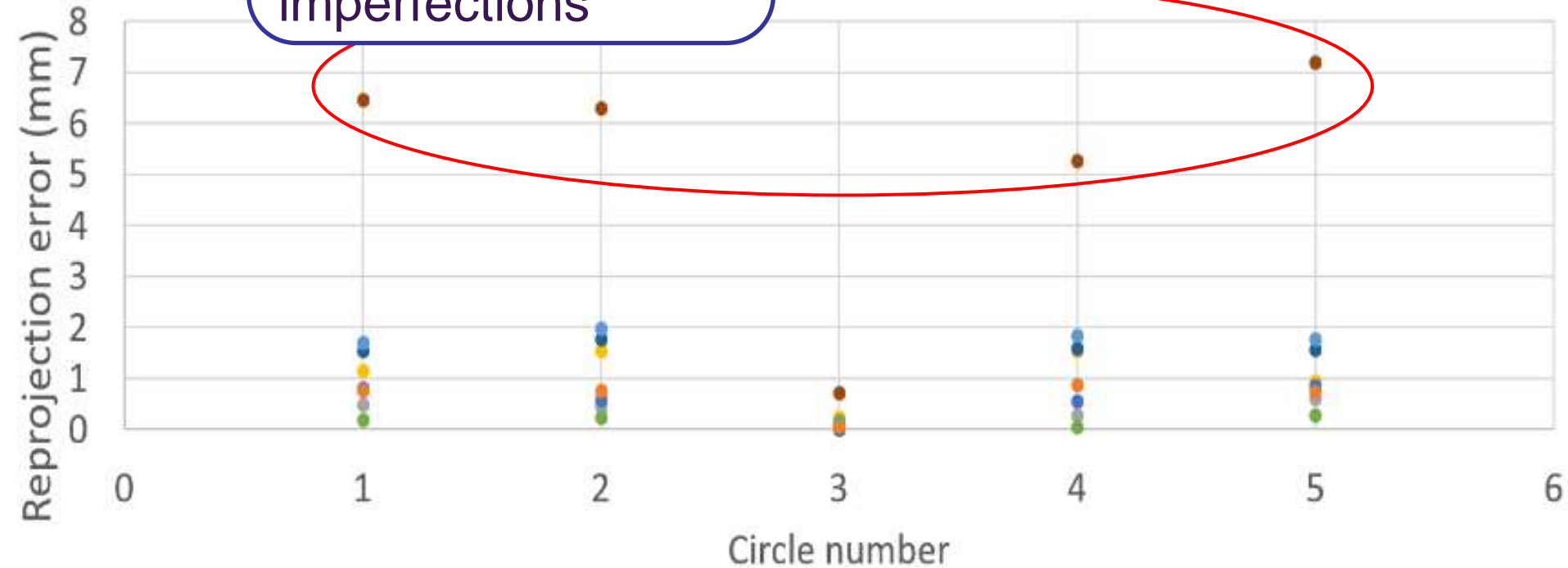
Large

0.029 m x 0.048 m x 0.069 m

0.21 m x 0.29 m x 0.005

More realistic with a rebuilt pattern and Gray floor with imperfections

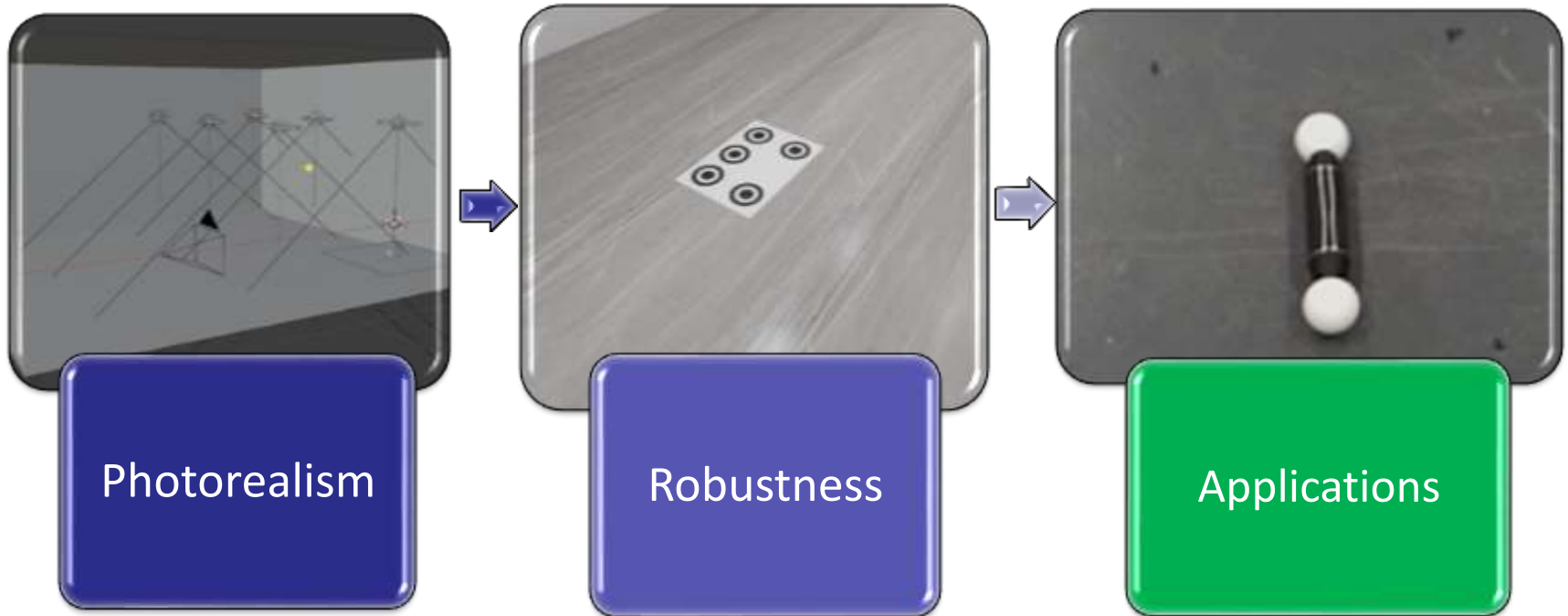
# Circle zone pattern



- Texture floor with scratches, image texture
- RGB texture floor with scratches, image texture
- Gray color with scratches, image texture
- Gray color, image texture

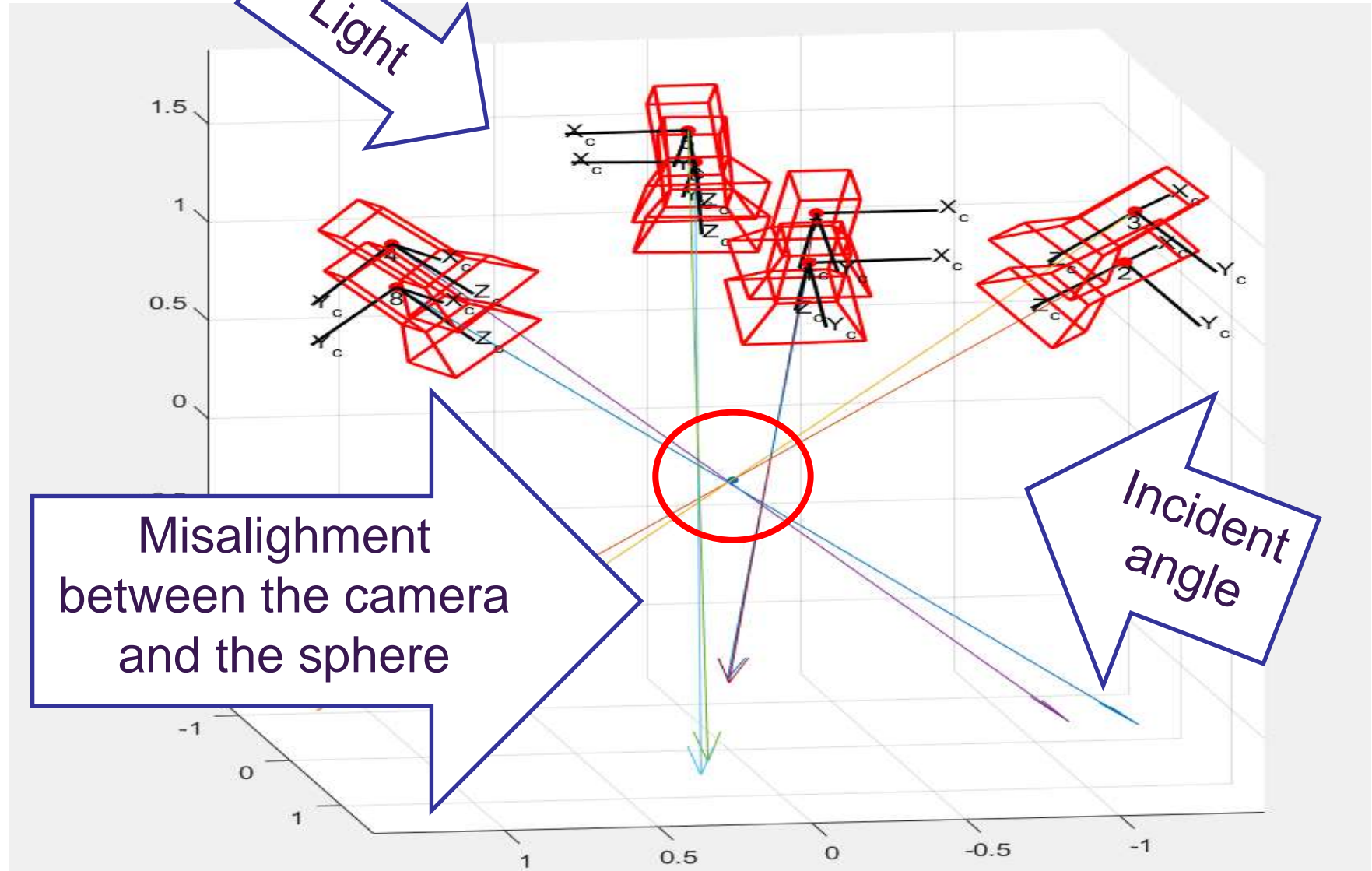
- Texture floor with scratches, rebuilt pattern
- RGB texture floor with scratches, rebuilt pattern
- Gray color with scratches, rebuilt pattern
- Gray color, rebuilt pattern

# Table of content

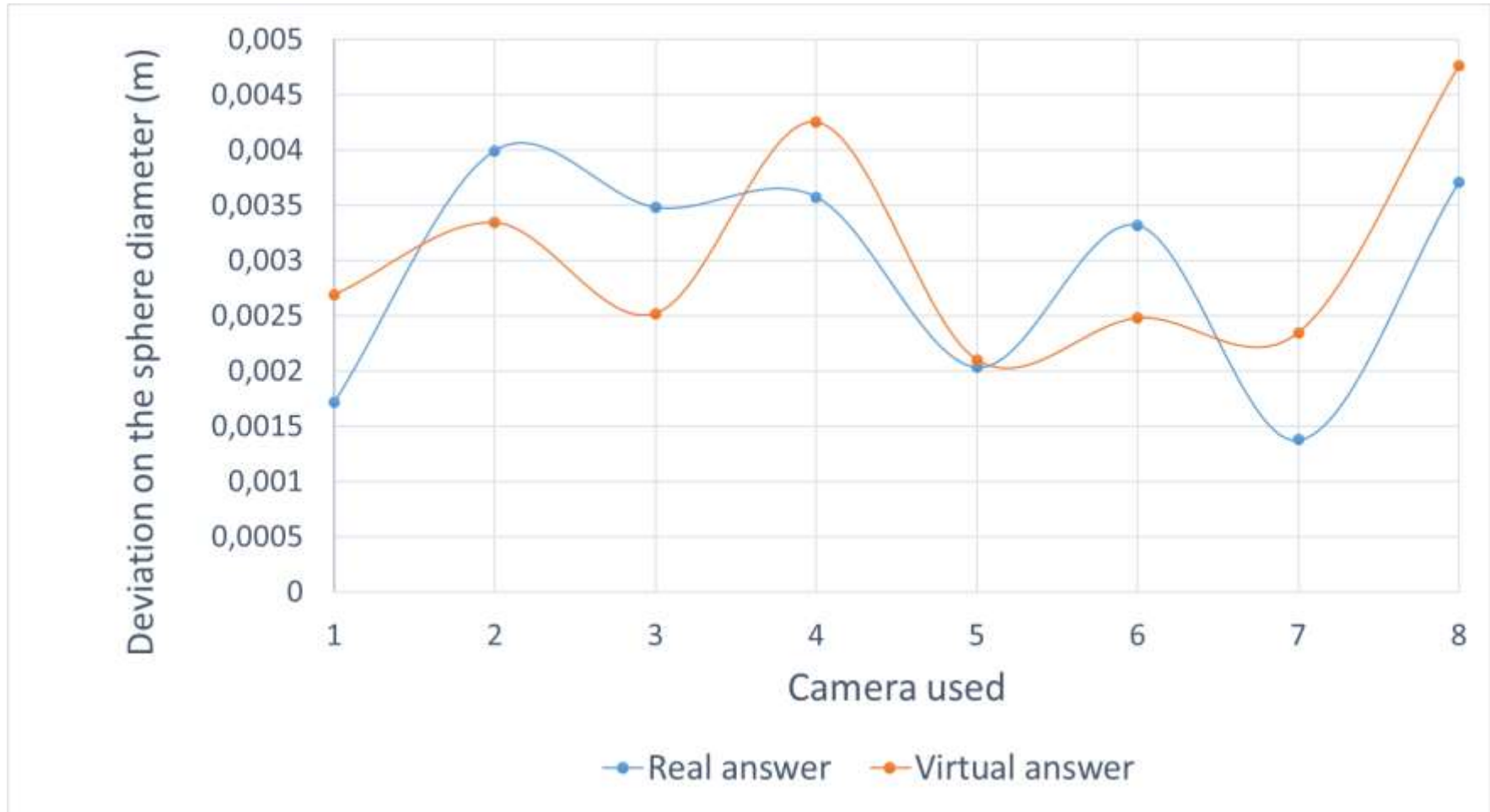




# Application



# Application



**3 mm difference between the real and virtual answers**

# Sum up



Designing a digital twin from an observant point of view

- Realistic
- An offset depending of the object
- Similar behaviours than the real system
- Law of optics respected

- Repeatability
- Validation of the model
- Robustness of the method

