

Verification and validation of Light Shutter System for the European Spallation Source (ESS)

D. Marschall¹⁾, Y. Bessler¹⁾, R. Lohoff¹⁾, G. Natour¹⁾, D. Lyngh²⁾, J. Koning²⁾

1) Central Institute of Engineering, Electronics and Analytics ZEA-1 of Forschungszentrum Jülich GmbH

2) European Spallation Source ERIC

Project description:

An important subsystem of the Neutron Beam Extraction System (NBEX) is the Light Shutter System (LSS) which was developed by European Spallation Source (ESS) to protect the experiment area from gamma radiation during shutdown with the Gamma Beam Shutter (GBS), as well as to position the Bridge Beam Guide (BBG) during operation. The LSS consists of a 4 m long frame, which is mounted onto the monolith, with a fixed ball screw connected to an actuator package with servo drive, brakes and resolver mounted below the frame.

Challenge:

The BBG must be repeatedly positioned vertically by the actuator in the path of the neutron beam and held in position by the brakes. A prototype of the LSS is being commissioned at the Central Institute of Engineering, Electronics and Analytics - Engineering and Technology (ZEA-1) to test the LSS. The prototype will validate the positioning system; and quantify the deviation of the measured values due to the forces occurring during test operation as well as external influences. This prototype is mounted on the Vertical Handling Test Stand (VHTS). The peak load on the system occurs during open loop operation of the servo drive, where the GBS and the BBG (weighing more than one ton) are allowed to drop under gravity to close the beam port.

ZEA-1 Solution:

The LSS is equipped with various measuring systems, to monitor different movements, forces and vibrations during testing. All sensors are connected to a central system for data acquisition. A measurement sequence will be designed, verified and validated with the analysis of single run ups to cyclic tests.

End position detection:

To measure the tilting of the GBS, BBG block and to reduce measurement errors three high precision laser triangulation sensors are installed per side. The reference position is the mounting location on the frame see figure 2.

Movement of the blocks:

To detect the movement of the blocks 3D space measurement with image correlation by markers on the GBS and BBG blocks is used see figure 3. The reference position is generated by markers on the frame. The accuracy is approx. 50µm depending on the field of view and thus on the length of the movement being tracked.

Force shock and vibration:

Force sensor integrated in the vertical actuator and between GBS and BBG. Additional sensors to measure the shock and vibration in open loop operation as well as during movement.

Environment:

To capture the effect of seasonal weather changes on test equipment PT100 Temperature sensors are installed along the frame to track the temperature profile.

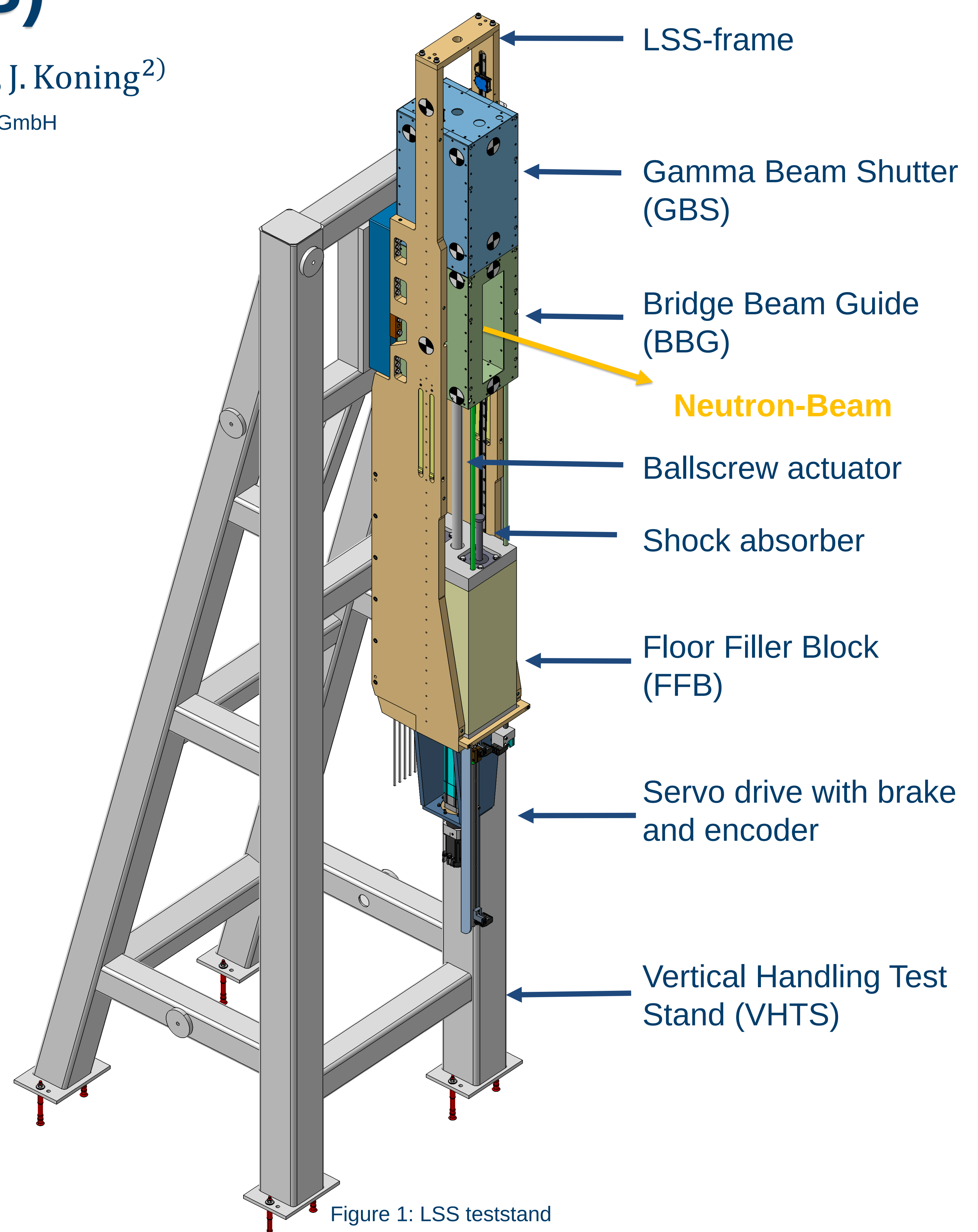


Figure 1: LSS teststand

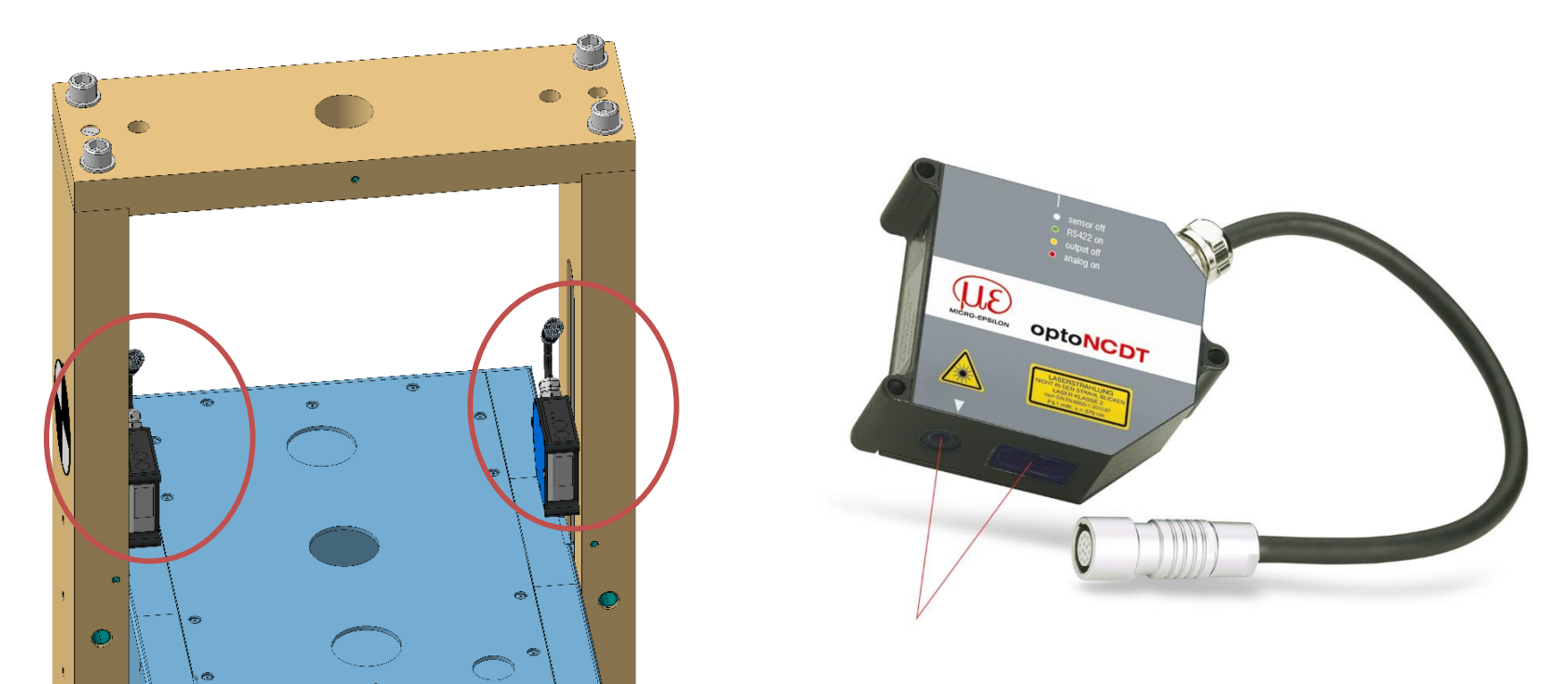


Figure 2: End position detection

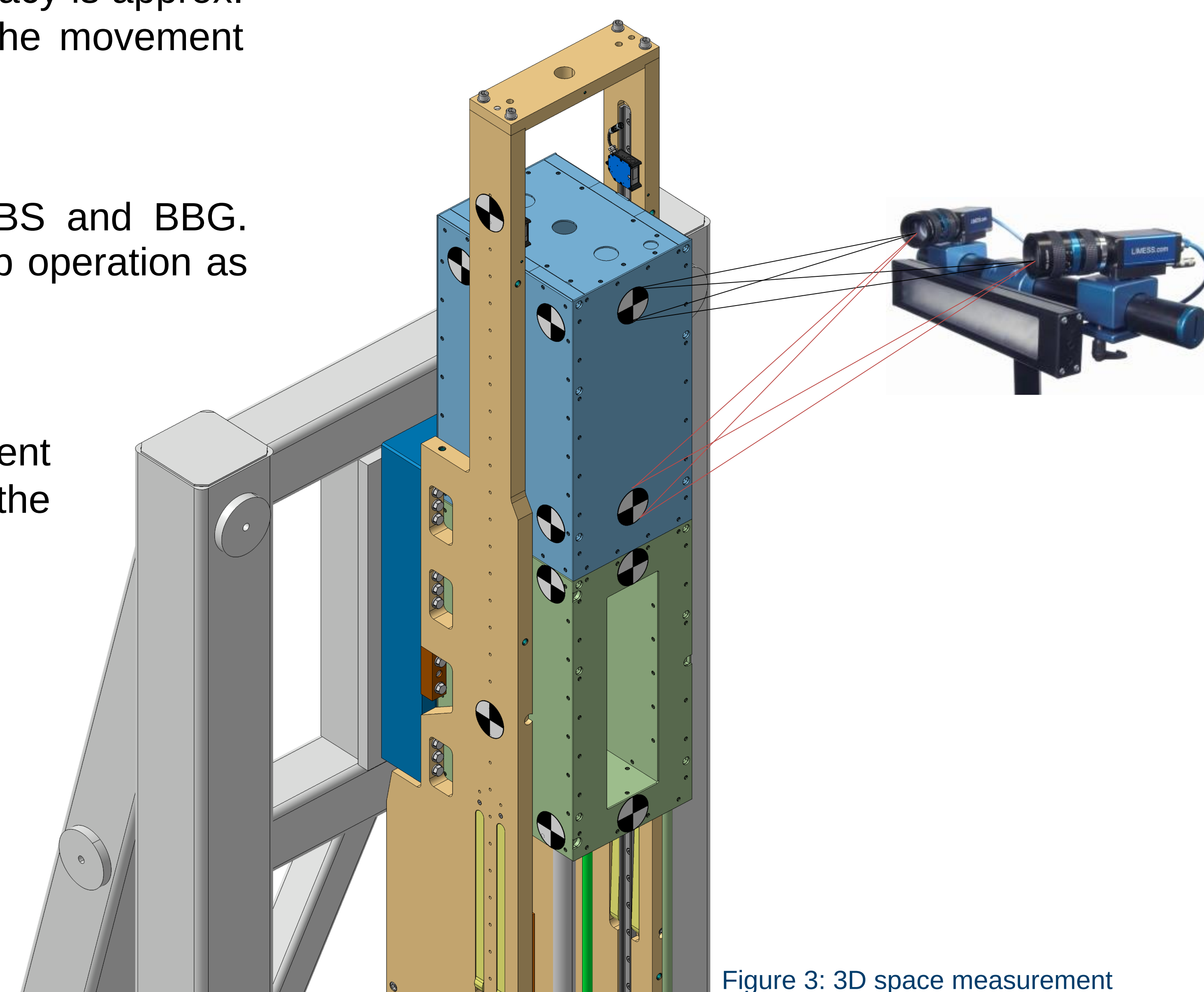


Figure 3: 3D space measurement