Design and optimization of a multi-camera structural test using pre-visualization

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Scientific visualization is a key aspect in today's science, especially due to the amount and complexity of data to process. To the authors' opinion, visualization aspects also appear to be of major interest for the pre-processing of experimentations. Its use is presented here in the case of a multiaxial, multi-camera test of a reinforced concrete joint.

Due to the complexity of the 3D behavior, with a localized damage in the form of cracks and their unilateral behaviors, the joints are difficult to model. Meanwhile, they influence the overall structure response during say a seismic loading. Assessing accurately their behavior is thus of utmost importance and has been the subject of several investigations in recent years [1,2].

One way to circumvent those difficulties is to resort to full-field measurements using stereo-correlation systems to capture the 3D kinematics [3], over different surfaces and at different scales [4], as well as the details of the joint degradation and the large scale deformation of the beams. These different needs and constraints lead to a complex setup: a cumbersome 2-meter long T-shape specimen, fixed to a multiaxial testing machine (hexapod) with many mobile parts, and 10 digital cameras to capture different regions of the specimen surface, as represented on Fig. 1.

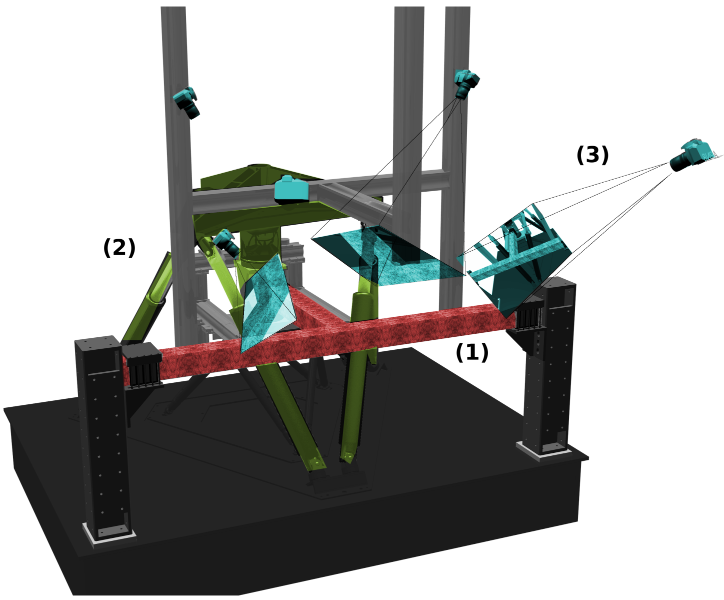

Fig. 1: *Blender* rendering of the experimental (partial) setup
(1) T-shape specimen (red), (2) multiaxial testing machine (yellow),
(3) several cameras capturing the scene (blue)

Thereby, many degrees of freedom (position of cameras and lightings) and constraints (shapes of the specimen and the machine) are involved in the global setup. Rather than resorting to a "trial and error" procedure to position the cameras, design using powerful 3D-rendering softwares is considered.

Visualization softwares are naturally accurate in their geometrical rendering, and this property can indeed be extremely beneficial to the design of complex mechanical tests including the optimization of camera positioning. A professional free and open-source 3D computer graphics software, *Blender* [5], is used in the present case. Additionally, one looks for very realistic synthetic images of the surface coverage, from which one can mimic the displacement measurement with a specific multi-camera stereo-correlation software. *Blender* includes actual surface patterning texture, lighting variations and even representative noise. Therefore, one can estimate the uncertainty of the measurements in quantitative terms, and thereby optimize the test.

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