SPECKLE ANAMORPHOSIS APPLIED TO DIGITAL IMAGE CORRELATION

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Digital Image Correlation (DIC) method is a non-contact optical method that provides full-field measurements of a deforming object. First of all, a speckle pattern is applied on the surface. Then, one (2D-DIC) or multiple (Stereo-DIC) cameras capture frame by frame the specimen under mechanical loading. The displacement field is finally computed by a DIC algorithm. The literature has shown great potential for the characterization of composite materials using 2D-DIC. Such materials are more and more implemented in the design of new aircrafts. However, in the study of large out-of-plane objects such as a wing or a fuselage using stereo-DIC, the precision of measurements decreases in the farthest regions from the cameras introducing noise in the results. In fact, with a regular speckle pattern composed of random dots of the same size, the farthest dots will appear smaller than the closest ones on the sensor screen due to perspective effects.
An optical anamorphosis is a deformation of an image unless the viewer is positioned at a certain position. To compensate for this limitation of stereo-DIC, the speckle pattern can be optimized by reducing the perspective effect induced by the orientation of the cameras using anamorphosis transformations (Figure 1). In this case, the speckle will be evenly projected on the sensor screen. A program has been developed to carry out anamorphosis transformations of a speckle pattern on planes and oriented cylinders. The program is also able to unfold the anamorphic speckle to print it on plane sheets. DIC static tests have been performed on planar surfaces and cylinders using anamorphic and regular speckle patterns. The obtained results are then compared: an improvement in the accuracy of the measurements by about 30-40% for planar surfaces and 4-40% for cylinders is shown. This method can therefore expand the use of stereo-DIC for 3D objects with more precise measurements over the entire surface.

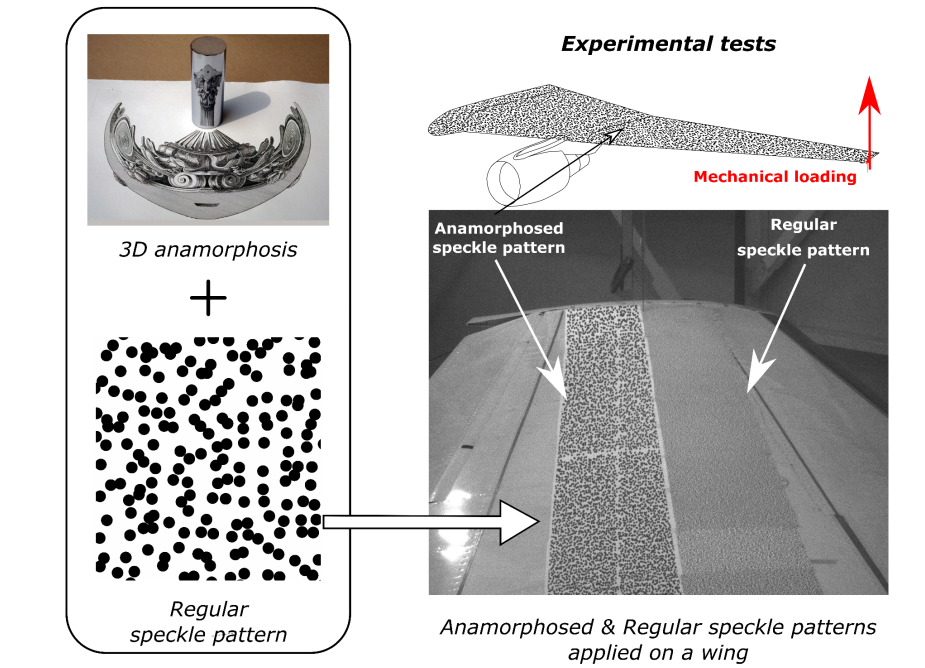

Figure 1: Speckle anamorphosis applied on a wing surface for the experimental tests: the left one is the anamorphosed speckle allowing more precised results on DIC analysis compared to the right one.