

Résumé

Simultaneous measurement of kinematic and thermal full fields are very important for thermomechanical procedures. Silicon-based cameras are widely used to perform real-time observation of the kinematic fields, mainly thanks to digital image correlation. Moreover, they are known to be as well sensitive in the near-infrared spectral range, thus the acquirement of thermal fields using a silicon-based camera is possible. However, there are two main problems for the silicon-based camera to obtain simultaneously kinematic and thermal fields. One is that in the near-infrared spectral range, a small temperature variation will lead to a large modification in the image gray level, which easily leads to poor quality images. Another is that digital image correlation needs a heterogeneous and contrasting surface, while the near-infrared thermography needs a homogeneous and constant surface. In this thesis, an innovative technique was proposed to automatically adjust the exposure time to obtain kinematically and thermally exploitable images whatever the temperature evolution occurs on the surface of the observed object. This technique was validated by different experiments, including blackbody heating experiments and realistic specimen heating experiments. Radiometric models of blackbody and specimen surface were calibrated respectively. Based on the radiometric models, thermal fields have been reconstructed on the kinematically and thermally exploitable images. High temperature tube ballooning experiment is conducted to perform kinematic and thermal fields. Global digital image correlation was performed to obtain kinematic fields. To perform near-infrared thermography on the specimen surface, radiometric model is calibrated based on portions of brightest pixels. In this case 20% of the brightest pixels is used to perform radiometric model calibration. Based on the radiometric model using 20% of brightest pixels, thermal fields are reconstructed. Combined with the known coordinates of kinematic field by digital image correlation, the thermal field at the same coordinates as kinematic field can be obtained.