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Image restoration for civil engineering structure monitoring using imaging system embedded on UAV

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Nowadays, civil engineering structures are periodically surveyed by qualified technicians (i.e. alpinist) operating visual inspection using heavy mechanical pods. This method is far to be safe, not only for civil engineering structures monitoring staff, but also for users. Due to the unceasing traffic increase, making diversions or closing lanes on bridge becomes more and more difficult. New inspection methods have to be found. One of the most promising technique is to develop inspection method using images acquired by a dedicated monitoring system operating around the civil engineering structures, without disturbing the traffic.
In that context, the use of images acquired with an UAV, which fly around the structures is of particular interest. The UAV can be equipped with different vision system (digital camera, infrared sensor, video, etc.). Nonetheless, detection of small distresses on images (like cracks of 1 mm or less) depends on image quality, which is sensitive to internal parameters of the UAV (vibration modes, video exposure times, etc.) and to external parameters (turbulence, bad illumination of the scene, etc.). Though progresses were made at UAV level and at sensor level (i.e. optics), image deterioration is still an open problem. These deteriorations are mainly represented by motion blur that can be coupled with out-of-focus blur and observation noise on acquired images. In practice, deteriorations are unknown if no a priori information is available or dedicated additional instrumentation is set-up at UAV level.
Image restoration processing is therefore required. This is a difficult problem [1-3] which has been intensively studied over last decades [4-12]. Image restoration can be addressed by following a blind approach or a myopic one. In both cases, it includes two processing steps that can be implemented in sequential or alternate mode. The first step carries out the identification of the blur impulse response and the second one makes use of this estimated blur kernel for performing the deconvolution of the acquired image. In the present work, different regularization methods, mainly based on the pseudo norm aforementioned Total Variation, are studied and analysed. The key point of their respective implementation, their properties and limits are investigated in this particular applicative context.
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