1 Introduction

In image capturing, digital sensors have practically displaced the use of photo film. Sensors have a number of advantages in comparison with films:

- Conversion of the intensity into digital data is instantaneous (as compared with the procedure of film processing).
- Sensors have a large enough dynamic range to achieve a high exposure latitude (it can be increased even more with special means).
- Rigid coordinate system may be defined in terms of the pixel number in the image.
- Sensor-receiving elements have high repeatability of the geometry and energy parameters.
- There is good correspondence of the image data flow with computer storage and processing.

These advantages are particularly essential for optical measurements. Progress in computer processor speeds and in calculation techniques led to a jump forward in the use of digital image processing such that it is now widely used in all fields of research, practically displacing pure optical analog methods.

In this Spotlight, we consider three fields in which measurements could be implemented with the use of an ordinary digital camera: distance, intensity, and wavelength.

1.1 Geometrical and correlation measurements

By "distance," we mean different measurements of shifts and deformations of different objects, i.e., all events resulting in changes in the spatial intensity distribution of the light fixed by the camera sensor. At least two shots of the object should be taken: one in the initial state and the other one in a changed condition due to shift, heating, load, deformation, and so on. Comparing the shots or video frames gives us information about the object or process. There are a number of methods used to obtain numerical data from a pair of pictures. One can calculate the sum of absolute differences, sum of squared differences, zero-mean sum of squared differences, locally scaled sum of squared differences, zero-mean normalized cross-correlation, and normalized cross-correlation. The methods differ in application fields, in the obtained information details, in the speeds of calculations, and in their computer memory requirements. Here, we consider only the correlation method, which is usually the most precise one, although it is also usually the most time consuming.

A significant feature of a digital image is that the fixed size of the pixels and the rigidly fixed spacing of their arrangement define a spatial discretization of the data. One might expect that the period of the pixel arrangement fixes the spatial resolution of the image. However, the precision of the measurement of the object