

Digital image analysis taken by smartphone camera for the characterization of atmospheric particulate matter collected on filters

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Atmospheric particulate matter, smartphone camera, digital image processing, RGB

1. SUMMARY:

This communication is focused on the development of a new methodology of characterization of the atmospheric particulate matter (PM) collected on filters by the digital analysis of images obtained using a conventional Smartphone camera, in order to obtain information on the levels and origin of the aerosol present in ambient air easily and with low cost. We will present the characteristic of image acquisition system and digital analysis method as well as the results obtained for PM₁₀ samples obtained from the monitoring station of air quality surveillance network of Extremadura (REPICA).

2. MOTIVATION and RESULTS:

Particulate matter is well known as one of the atmospheric pollutants with the most contrasted evidence about its impact on health condition, together with ozone, nitrogen dioxide and sulphur dioxide [1], PM_{2.5} and PM₁₀ being of special concern to human health. Therefore, monitoring PM pollution and controlling their levels in ambient air have become main objectives of the environmental protection agencies and public health protection organizations.

Currently, surveillance of PM levels to comply with health protection regulations [2] is carried out through sophisticated instrumentation installed in field units within air quality monitoring networks, where the measurements are performed by advanced automatic equipment based e.g. on beta-attenuation or light scattering, that provide continuous data, or by the official method (EN 12341:2015) based on PM collection on fiber filters followed by gravimetric analysis. Although these methodologies provide reliable results, they require complex and expensive equipments installed in conditioned environments with continuous maintenance by specialized technicians, and do not allow decentralized measurements. In order to solve these drawbacks, in recent years different sensors to monitor particulate matter concentration have been developed, with the goals of simplicity, portability and low cost. In addition, many of them provide data in real time using associated mobile applications for easy data management.

Based on these new sensors and the previous works that used the digital analysis of sky pictures [3, 4] as a source of physico-chemical information about PM, the present work has the main objective of exploring digital analysis of conventional smartphone camera images from samples of particulate matter captured on filters to monitoring and quantify their levels in ambient air. To our knowledge, this is the first report about the use of a Smartphone camera as a tool to estimate PM levels based on colorimetric measurements of the aerosol collected on filters for environmental pollution assessment purposes.

The intensity of the particulate matter colour in RGB system was determined by applying the mobile application (APP) "Color Grab" to the images taken from the filters. The RGB parameters obtained were analysed through statistical procedures, directly or transformed to greyscale algorithms. The results of the study show that the methodology can correctly estimate the concentration of PM₁₀ by a significant linear correlation between the concentration of PM₁₀ measured by an official gravimetric method and the RGB/greyscale parameters, with better results in the case of the blue channel and the lightness greyscale

algorithm. The methodology can also discriminate urban and rural sampling locations affected by different local particle-emitting sources and is also able to identify the presence of remote sources such as Saharan dust outbreaks in both urban and rural locations.

The main conclusion of the present work was that the methodology of digital analysis of filter pictures can be considered a promising first approach towards a simpler, faster and more miniaturized system for measuring the concentration of PM in ambient air than conventional ones.

Acknowledgements:

We acknowledge the Interreg-Sudoe project NanoSen-AQM (SOE2/P1/E0569), Junta de Extremadura, Spain (projects PRI IB16114 and GR18068), and the air quality surveillance network of Extremadura (REPICA), all partially financed by European Union Funds for Regional Development (FEDER).

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