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ITTECOP
Infrastructures de transports terrestres écosystèmes et paysages

PARIS EST SUP

Research internship sheet

Inference of air quality by vision-based estimation of the atmospheric visibility

Societal issues

The degradation of air quality is a major issue on a global scale. Indeed, it is the cause of many premature deaths. It also impacts biodiversity, in particular through the acidification of natural environments that it causes. The public authorities are developing mitigation tools, such as Low Emission Zones, tools that need to be evaluated over time. With this in mind, the territories are partially equipped with reference air quality measurement stations, mainly in metropolitan areas, but their insufficient number does not allow all types of territory to be precisely covered, in particular rural and natural areas. As atmospheric pollution impacts the visual appearance of landscapes through the haze it causes [5], artificial vision may possibly be used to infer information about the air quality, for instance through the use of deep learning methods. This may allow a better access to air quality data on all the territories [1]. These methods nonetheless require reference air quality data, data which is precisely not available in the targeted territories, which hinders the use of artificial vision.

State of the art

- Meteorological visibility

The meteorological extinction coefficient of the atmosphere, generally denoted by k, characterizes its ability to diffuse light, mainly solar light. It is related to the density of suspended water droplets. k is closely related to the meteorological visibility distance Vmet which is the farthest distance at which a black object of sufficient size can be seen against a sky background. Koschmieder's law makes it possible in particular to connect the two quantities by the following simple relation: Vmet = 3 / k. Thanks to this equation, k can therefore be measured simply and directly using optical instruments, but also estimated by artificial vision [4].

- Air quality

Air quality is usually measured by a composite index (AQI) of the various gases and particles present in the atmosphere, an index which does not seem standardized, but which is revised regularly to take into account the most relevant and recent knowledge on health effects. Some of these particles aggregates water to produce suspended water droplets and therefore partially links k with AQI.

Purpose of the internship

In this context, the purpose of the internship is to explore how a method for estimating air quality by artificial vision can be developed that could possibly do without a reference in terms of air quality. The state of the art in computer vision in degraded atmospheric conditions has grown considerably over the past ten years. Many papers have thus focused on restoring images degraded by atmospheric conditions [3], and detecting the occurrence of fog [4]. Since this work in the 2000s, new results are now obtained using deep learning, in particular [2] which offers a relative estimate of the atmospheric visibility (i.e. without absolute meteorological reference). More recently, different teams have started to use deep learning for the inference of air quality with reference [1]. The internship will also contribute to the IPAVIA incubator project selected by the ITTECOP research program operated by the Ministry of Ecological Transition with the support of ADEME.

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