Convocatoria 2022 - «Proyectos de Generación de Conocimiento»

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TÍTULO DEL PROYECTO (ACRÓNIMO): Emisión de MFs al medioambiente: Uso de herramientas de Deep Learning para su identificación y cuantificación (FIDEL)

TITLE OF THE PROJECT (ACRONYM): Plastic MFs emitted to the environment: Use of Deep Learning tools for their identification and quantification (FIDEL)

Código del proyecto: PID2022-138524OB-I00

Textiles are a major source of microplastics pollution also known as microfibres (MFs). For example, the abrasion of synthetic textiles during household washing can release up to 700,000 acrylic MFs per wash. According to literature, the amount of MFs shed during laundry is influenced by factors such as temperature, washing time, the characteristics of the detergents and the type of washing machine. Despite the several studies on microfiber shedding during domestic laundry, the lack of a standardised method for measuring them makes it difficult to compare the results between different studies.

The most commonly used methods for measuring microfibers are visual counting and gravimetric methods. The main drawback of visual counting is its low reproducibility due to human error. Meanwhile, the gravimetric method can be affected by interference such as detergent residue. Recently, The American Association of Textile Chemists and Colorists (AATCC) and The Microfiber Consortium have developed a method for measuring MFs (AATCC TM212-2021) based on the ISO 105-C06. However, this method must be carried out without the addition of detergent or auxiliary cleaning products. As a consequence, it does not reproduce the conventional domestic washing conditions.

On the other hand, the textile industry generates wastewater containing MFs, especially during the dyeing and finishing processes. However, to the best of our knowledge, there are no studies on the quantity of MFs released during the textile production process. Therefore, there is currently a knowledge gap on the real impact of microfiber shedding.

Taking into account the above, the objective of this proposal is to develop and validate a new procedure to identify and quantify MFs. This procedure will be focused on the use of Deep Learning techniques, a subset of Machine Learning, aiming at training neural network architectures to recognize the microfibres in an image. Then, given an image, such techniques can be applied to detect and count the number of MFs present in it. In addition, a hyperspectral camera will be used, which will provide information on the composition of the MFs. In this sense, the neural network will also be trained to identify and classify the MFs. It is important to highlight that this new procedure will be evaluated for the quantification and identification of MFs at both a domestic and an industrial scale.

The development of such an architecture presents a challenge as well from the computer vision perspective. The problem to be tackled is known as “overlapping instance segmentation”, where several objects in the scene are to be independently identified in spite of presenting partial (and possibly large) occlusions. This problem has been historically studied in contexts such as detection of cars or pedestrians in outdoor images. Nevertheless, the research community also addresses scenarios closer to (but usually less complex than) the MF images to be studied in the FIDEL project.

The study of a new procedure for MFs quantification and identification could achieve a set of social and scientific impacts. From a scientific point of view, currently, there is no standardised methodology for the analysis of the microfibers present in industrial wastewater. Therefore, the development of a new scalable and reproducible procedure could solve this problem. It should be noted that the method proposed in this project could be applied in the analysis of all typesof liquid effluents (urban, rivers, industrial, etc.).

The implementation of the procedure developed in this project would facilitate a more comprehensive understanding of the quantity and diversity of microfibers present in water sources, including industrial wastewater, enabling the identification of primary sources of contamination and the formulation of strategies for mitigation. Additionally, it would enhance the efficiency of wastewater treatment or the development of new treatment techniques and technologies. It is important to note that the presence of microfibers in water can have negative effects on aquatic fauna and biodiversity since microfibers can be ingested by organisms.

The project has a duration of 36 months.