Polymer Waste Sorting Technologies to Support the Circular economy

M. Maniadakis, G. Alexakis, N. Tsagkarakis

Foundation for research and Technology Hellas (FORTH), Herakleion, Crete, Greece

Recycling post-consumer packages is a key component of the circular economy. Currently, there are two main approaches for identifying and sorting polymer waste packages. The first regards the processing of high quality RGB images which are fed into deep neural network models that identify and categorize waste objects. The second regards hyperspectral imaging, which focuses on classifying the material piece associated with a single pixel as being composed of a specific type of material. Understanding the difference between these methods is crucial for optimizing recycling processes.

RGB (Red, Green, Blue) images sample and encode the information available in the visible domain. Computer vision based on Deep Neural Networks (DNNs) enable machines to interpret and understand the visual world. After describing the problem with a large dataset of problem-solution images, a deep neural network is trained to recognize patterns and features of interest and learns to identify and categorize polymers in subclasses (PETE, HDPE, LDPE, etc), based on appearance.

Near-infrared (NIR) hyperspectral imaging enhances waste sorting by enabling the separation of materials based on chemical composition. Each pixel of hyperspectral images captures a wide spectrum of wavelengths. By contrasting the recorded spectrum against known spectral signatures used as references, we categorize the corresponding material as a member of certain category. Main difficulties on HSI imaging relate to materials that are dirty, wet, and most commonly have on them labels made of other materials.

Following the above, there is a need to merge the two technologies, devising a novel strategy that mitigates their weaknesses while amalgamating their advantages into a robust approach with significantly enhanced success rates. The current presentation will discuss alternative options and will present early results on the combined sorting of polymer waste using RGB and HIS data.