Funded PhD position in machine learning applied to diatom ecology

Title

Automatic recognition of microalgae (diatoms) using a deep-learning approach for the ecological diagnosis of freshwaters

Keywords

machine learning, CNN, computer vision, imagery, ecology, biomonitoring, diatom

Abstract

Diatoms are ubiquist microalgae inhabiting all aquatic environments. They are widely used organisms in freshwater ecological assessment (biomonitoring). However, the most efficient diatom-based diversity indices require a high level of taxonomic knowledge, which involves time and expert training. Traditional taxonomic identification of these organisms is based on the observation of both shape and ornamentation of their frustule, a highly ornamented silica shell, using conventional optical methods (Fig. 1). These morphological features/traits are not always easy to characterize, depending on the experience of the operator, the quality of the image and the continuous evolution of diatom classification. Thus, the estimation of diatom-based diversity indices is often prone to multiple biases, implying that the development of a genuine tool is needed for supporting decision-making based on diatom identification.

Fig. 1: typical images of different diatom species observed under the microscope (x1000) using permanent slides.

Automatic classification of diatoms has remained a challenge since the first attempts during the 90's, but the recent development of deep learning approaches are promising for solving image-based diatom classification problems. In this context, we aim at developing algorithms for an automatic identification of diatoms using image information derived from handcrafted and/or unsupervised morphological features.

Our team has recently developed a first deep-learning pipeline for diatom detection and classification based on a synthetic dataset. These algorithms must now be adapted and applied to real images, representing the assemblages of species encountered in watercourses. This tool will then be applied to the calculation of the Biological Diatom Index (IBD), which has been used routinely in surveillance networks since 2000 in France within the implementation of the European Water Framework Directive (WFD). On the long term, this tool should help addressing more general ecological questions.

General information

Financial support is available for 3 years (approx. 2000 EUR net/month, before taxes) from ANR, Région Grand-Est and Université de Lorraine. The position should start October 1st 2020. It will be located at the Laboratoire Interdisciplinaire des Environnements Continentaux (LIEC, UMR 7360 CNRS-Université de Lorraine), in strong collaboration with GeorgiaTechLorraine (GTL, UMI 2958 CNRS/GeorgiaTech), both situated in Metz, France.

The PhD candidate will be supervised by Dr Martin Laviale (diatoms, LIEC), Pr. Philippe Usseglio-Polatera (HDR; biomonitoring, LIEC) and Pr. Cédric Pradalier (machine vision, GTL). He/she will also collaborate with the CEREGE (Aix-Marseille, France, imagery) and benefit from the international network ARTIFACTZ dedicated to machine learning applications for aquatic organisms' imaging (https://sites.google.com/view/artifacz/home).

Candidate Profile

We are looking for a person willing to work at the interface between ecology and applied mathematics/computer sciences. Previous experience in machine learning/computer vision applied to biology is welcome but the applicant should demonstrate a strong interest for ecological applications. The ideal candidate will be self-motivated, scientifically curious and possess good communication skills in order to interact with experts from different disciplines.

Application

Candidates with the desired profiles should send a CV and a letter of motivation (including the contact details of previous supervisors) to the three PhD advisors (martin.laviale@univ-lorraine.fr, philippe.usseglio-polatera@univ-lorraine.fr, cedric.pradalier@georgiatech-metz.fr). Relevant applications will be selected for further oral interviews early July. Applications will be considered until the position is filled (final deadline: July 15th 2020).

Relevant selected bibliography (pdf versions available on demand)

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