STEREOSCOPIC METHODS FOR THREE-DIMENSIONAL TRACKING OF EXPLORATORY BEHAVIOR OF BARNACLE CYPRIDS

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An important step before colonization of surfaces by sessile marine biofouling organisms is surface exploration. During this step, the microorganisms evaluate different surface properties as well as different environmental factors in order to find an appropriate site for permanent settlement. This exploration is a fast process involving three-dimensional swimming motions and its quantitative analysis requires respectively the recording of temporally resolved three-dimensional swimming trajectories. Two dimensional tracking [1] has been proven to be suitable for identification of attractive and repelling surfaces, in terms of biofouling, and provided a new insight into selection strategies [2]. However, a clear separation between active (exploration, swimming) and passive (floating) phases of the swimming trajectories proves to be complicated. Another imaging method (Digital Inline Holographic Microscopy, DIHM) provides the needed features, but works optimally only with objects at size of around 20 µm [3], which is not sufficient in the case of cyprids (depending on the species, size varies in the range of 100 µm – 1000 µm). We present a transportable, submersible stereoscopic system which can be applied to record three dimensional video data and extract swimming trajectories of multiple, label-free objects. The hardware setup is presented and discussed. Introducing the mathematical basics of stereoscopy, we describe the resolution and perform empirical error analysis in order to obtain the error values of the system. First trajectories of barnacle cyprids on chemically different surfaces (PEG2000-OH, $C_{11}NMe_3^+Cl^-$, acid washed glass (AWG)) are extracted and evaluated in respect to known patterns (swimming velocity, swimming angle, etc.).

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