Docket #: S17-180

Hydrodynamic Treadmill: Novel tracking microscope to observe biotic/abiotic systems as they move over large distances

Stanford researchers have developed a hydrodynamic treadmill system for a tracking microscope that allows long term observations of biological and abiotic systems over large length and time scales. It is very challenging to study small objects (1um to 1mm) that move great distances (hundreds of meters) because it is difficult to bridge the vast difference in scales between the observed object and the observation volume. Current optical tracking systems are non-ideal as they are large, complicated, expensive and cannot accommodate the full range of expected motion.

To overcome these limitations the inventors have developed a hydrodynamic treadmill for a tracking microscope that effectively provides unlimited space for vertical motion. It allows micro/mesoscale (1um to1mm) biotic and abiotic systems to be tracked and observed under the influence of hydrodynamic forces and a gravitational field. The system allows for observations over extensive time (tens of hours) and long length scale (hundreds of meters). This technology provides a method to bridge the difference in scales and enable the observation of really small entities over great distances.

Hydrodynamic Treadmill Video

Stage of Development
The inventors have developed a prototype and validation studies show great promise.

Applications

- Research tool for:
  - Marine ecology, biological oceanography and physical oceanography
    - Tracking marine microorganisms
  - Atmospheric sciences
    - Observing sedimenting microparticles and microdroplets
  - Material sciences
    - Observing the growth of microcrystals
  - Cell biology
    - Tracking circulating cells
  - Pharmacology
    - Drug development and screening
  - Fluid mechanics and transport phenomenon

Advantages

- Solves an unmet need by providing the means to study microscale objects over macroscale lengths and time periods
- System can accommodate ecologically relevant variations in the environment, such as light, temperature, nutrient concentration, salt concentration and chemoattractants
- Enables the study of uniform flow past micro/mesoscale objects that rise/sink in an ambient fluid
- Objects under study have the freedom to move great distances
- Observations can be made over long time periods (tens of hours)
- System is compact
- System may be integrated seamlessly with conventional microscopes as a replacement tracking stage

Publications

- D. Krishnamurthy, H.Li, F.B. du Rey, P. Cambournac, A.Larson and M. Prakash Scale-free Vertical Tracking Microscopy: Towards Bridging Scales in Biological Oceanography *bioRxiv* posted April 15, 2019.

Patents

- Published Application: 20190000044
- Issued: 11,033,006 (USA)

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