

# Propositions

accompanying the dissertation

## 3D TRACKING OF MOTILE MICROORGANISMS

AN EXPERIMENTAL INVESTIGATION OF THE KINEMATICS AND INTERACTIONS OF *C. REINHARDTII*

by

**Junaid MEHMOOD**

1. The four-camera microscopy system enables tracking at one order of magnitude higher image densities and particle concentrations compared to conventional defocused phase contrast and holographic approaches. (This thesis, Chapter 2)
2. Despite increased particle overlap at higher densities, the multi-camera microscopy system supports higher tracking accuracy compared to traditional holographic methods. (This thesis, Chapter 2)
3. Understanding the biological noise originating from differences in flagellar frequency, asynchrony, and velocities is crucial for accurately predicting the interaction dynamics of *C. reinhardtii*. (This thesis, Chapter 3)
4. The constant rotation rate of *C. reinhardtii*'s helical trajectories across both Newtonian and viscoelastic environments suggests an active cellular mechanism that facilitates accurate environmental scanning for effective phototaxis. (This thesis, Chapter 4)
5. The spherical cow approach is moot for complex biological systems characterized by significant noise, such as the locomotion of microswimmers.
6. Physics papers involving numerical studies should only be published if their code is made open-source.
7. A government system that integrates meritocracy with democracy is better equipped to combat disinformation, thereby electing competent leaders.
8. PhD programs should train students in prompt engineering to efficiently edit and proofread their papers and improve their writing skills using tools like ChatGPT, Gemini, and Claude.
9. The threat of artificial intelligence (AI) to human civilization is exaggerated.
10. Given the many-worlds interpretation of quantum mechanics, the research in this thesis is completed two years ago in another universe.

These propositions are regarded as opposable and defensible, and have been approved as such by the promotor dr. D. S. W. TAM and the copromotor dr. A. J. Buchner.