Joshua Wang - Junior at Brookfield Central High School

Hobbies: Robotics, Tennis

Clubs: Science Bowl (Captain), FTC Robotics (Design/Software Lead), Varsity Tennis

Experience and Honors: USAPhO Silver (2022) and Gold (2023-24), AIME Qualifier (2020-24), USAJMO HM (2022-23), USAMO Bronze (2024), PRIMES-USA Research (2024), IJSO Gold (2021), FIRST Championship (2019, 2022, 2024), NSB Nationals Top 16 (2019-22)

Autobiography:

My journey into physics, like that of many other students, started with math – but it could never have ended there. Because physics is a field with deep connections to mathematics, and one where theory and experiment can be meaningfully separated, it is tempting to view physics as a consequence of mathematics - the arbitrary realization of some underlying equation or principle. However, this viewpoint wasn't very useful for a younger me, taking my first steps towards formalizing the workings of the world. It is my opinion that thinking of a physical object as, first and foremost, a mathematical object is not a productive way to appreciate physics; there was a certain disconnect, larger than one might think, between my mental model of real life and the idealized models of a point mass affected by gravity and friction, or of a two-terminal circuit element satisfying "V = IR". Because of this, the concepts of physics didn't really "click" until I could phrase them in a language less formal than equations. For me, robotics was the perfect avenue to experience this shift in perception.

The roboticist must reconcile two competing notions - the desire for ideal, easily modelable systems and the acceptance of pesky realities like friction and hysteresis. The mechanical designer of a system thinks in terms of the former, while the programmer must compensate for the latter. Occupying both of these roles at one time or another refined my view of physics – now, I couldn't hope to completely encompass the physical within the mathematical, but had to make do with better and better models that incorporated imperfections instead of shrugging them aside. The point mass with constant acceleration led to an extended body with rotating wheels, and then to consideration of the dynamics of a DC motor. This development led naturally to my current interest within robotics: control theory, the art and science of making a real, imperfect system do exactly what you think its mathematical counterpart should be able to. There is a certain satisfaction that comes from seeing your robot, beset by friction and noise, make fluid, repeatable motions which, for me, circling an answer on a paper could never match.

Of course, one cannot hope to completely reformat their mathematical knowledge of physics into an intuitive knowledge. I find that I can't yet think meaningfully about traveling at 0.9c or being in a probabilistic superposition of states; thus, my journey from human-scale knowledge of physics into the realm of the abstract begins once again. Now, however, I am armed with the belief that I can simultaneously develop mathematical understanding and true intuition. This new leg of my journey will take me through the 2024 US Physics Camp, and I am grateful for everyone who has helped me along the way, including the developers of online

resources, my robotics mentors and supportive physics teacher, and of course my parents, who first pointed me in this direction and have kept me on track ever since.