MATH OUTSIDE THE BUBBLE

Your Favorite Field a Superpower?

Sophia D. Merow

In S. L. Huang's sci-fi thriller *Zero Sum Game*, narrator Cas Russell wastes little time showing off her superpower. When, within the first 25 pages, the retrieval-specialist-for-hire[1] needs to unobtrusively overhear the men in dark suits searching a client's cottage, she surveys her surroundings and, building off the near-conic curvature of a stone wall, tweaks the street space to amplify the sound waves of interest. She kicks a trashcan, closes a gate, upends a water bowl, reorients a bird feeder. Then, positioned at the focus of her "manufactured acoustic puzzle," Russell opens an umbrella she has nabbed from a nearby car—and listens.

This credulity-stretching ability to create on the fly an acoustic phenomenon usually achieved only through laborious engineering is trademark Cas—not so much impossible as just really *really* unlikely. "I try to make everything my protagonist does *realistic* if highly *improbable*," explains Huang. "I want it to be something that could actually happen, but that no human would be able to do intentionally without a lot of equipment."

The idea for Cas's character grew out of Huang's own daydreams of putting her mathematical knowhow to real-world use. A weapons expert and sometime Hollywood stuntwoman with a BS in math from MIT, Huang has long wished that computational facility entailed physical ability—to do backflips, hit home runs, hang picture frames straight on the first try. "It never seemed fair that I could do the exact equations necessary to figure out the right force or angles but couldn't actually make any of it happen," Huang told SyFy (see `https://bit.ly/2PdaRrB`). "If a person could make her reality match calculation, what kind of powers would that give her?" The Cas Russell series (see Figure 1) is Huang's answer to that question.

Huang's study of pure mathematics did not equip her to script the exploits of her math-genius mercenary, of course. ("I didn't, for example, take classes in the mathematics of exploding buildings or how blood spatters when someone is murdered," she told Maria Alexander; see `https://bit.ly/2JdyD2Q`.) So before drafting a scene in which, for instance, Russell shoots a grenade out of the air, Huang does enough reading and scratch-paper scribbling to have a solid grasp of the computations Cas is performing at lightning speed. She also admits to slipping in nods to friends' research when possible: "I can't describe the thrill of having a professor friend say, 'I can't believe you put computability of subshifts in your books!'"

While Huang's self-described "eccentric mathematical superhero fiction" certainly contains details and allusions to tickle the math-savvy reader—Huang talks about "having mathiness seep out the pores" of the work—readers need not satisfy a quantitative prerequisite to engage with it. Indeed, if Huang has a math-related goal for the Cas Russell novels, it's more about representation than representation
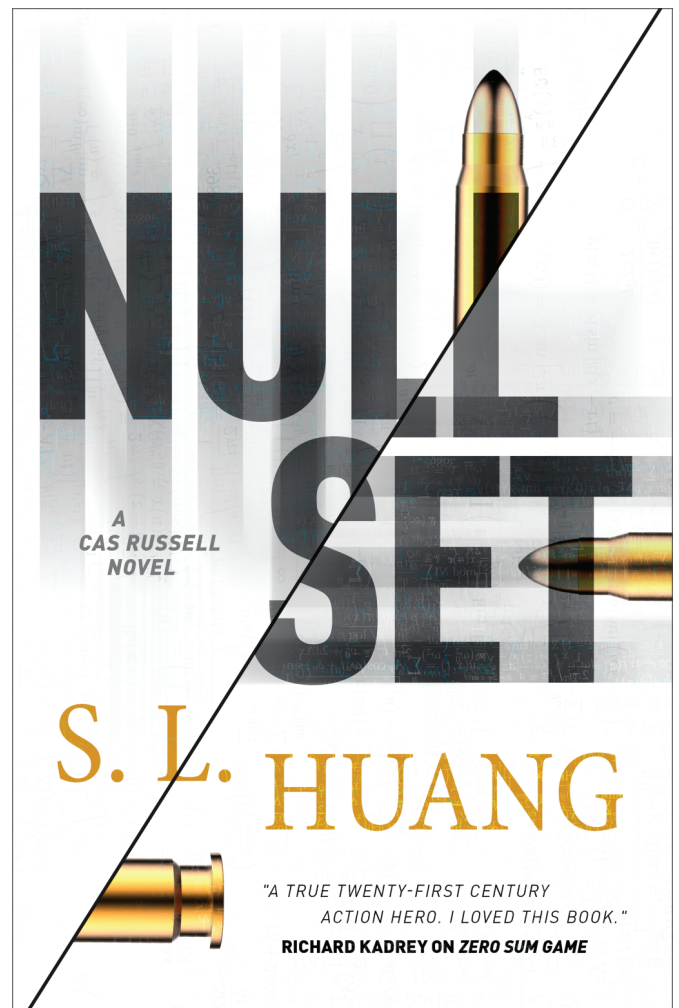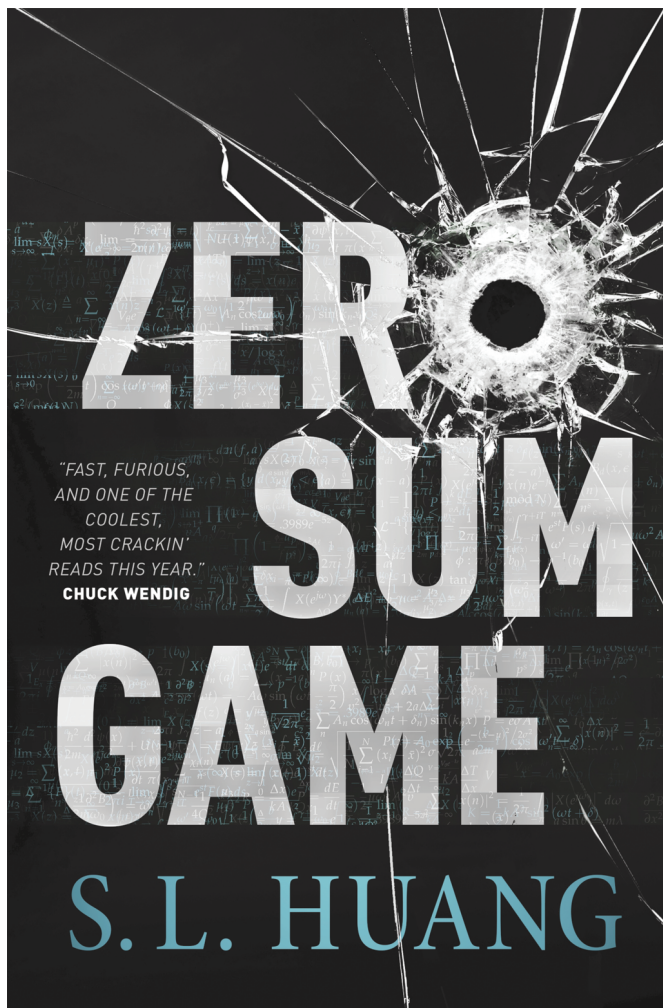
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[1] *"I do retrieval," Russell tells a woman she has just extracted from a drug cartel's compound. "It means I get things back for people. That's my job."*

Figure 1. The first two books in the Cas Russell series, as published by Tor. To inform the cover art, Huang provided the designer with a 16-page LaTeX document titled "Aesthetically Pleasing Math Equations: An Incomplete Reference List."

theory. Huang cast a woman of color as her (anti)hero, an intentional choice calculated to impress upon young women the potential power of mathematics in female hands. Sure, the math portrayed in *Zero Sum Game* and its sequel *Null Set* is not the sort one learns in college or makes a living doing, but the books do, in their sci-fi way, normalize the conjunction of "math" and "woman." "No one piece of media can be everything that's needed to represent a better gender spectrum in mathematics," Huang says, but bit by bit television shows and movies and graphic novels[2] and biographies can chip away at the narrow-minded popular conception of what a mathematician looks like. "I consider myself only one drop in the effort to push back on those assumptions."

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[2] *Asked for notable examples of pop-culture mathematicians, Huang cites David Krumholtz as Charlie Epps in CBS's* Numb3rs*; Jeff Goldblum's Ian Malcolm in* Jurassic Park*; and the fictionalized, steampunk version of Ada Lovelace in Sydney Padua's* The Thrilling Adventures of Lovelace and Babbage *(reviewed in the May 2017* Notices*; see* https://bit.ly/36fCTcd*). "One of my favorite fictional mathematicians ever," says Huang, "is Kel Cheris in Yoon Ha Lee's* Machineries of Empire*."*

Huang describes the math community's reaction to her writing as "overwhelmingly positive." Math enthusiasts have recommended her own books to her (not realizing she authored them), and worries that she would get "hate mail from mathematicians who found a mistake somewhere" have so far proven unfounded. "Instead, I've gotten a fair number of messages from math people who…were thrilled seeing their favorite field become a superpower," Huang reports.

Huang does have her critics, however. College of Charleston mathematician and cataloger/reviewer of math fiction Alex Kasman, for one, did not come away from *Zero Sum Game* appreciating Huang's behind-the-scenes scratch work. "Mathematical terminology is tossed around without any explanation or even very much thought," Kasman writes (see https://bit.ly/31DwZhi), comparing Huang's use of math lingo to the "techno-babble" about anti-matter and higher dimensions typical of much science fiction. "I guess what I'm saying is that the math seemed *gratuitous*." Kasman does concede, though, that "it is nice that an author

thought math was interesting enough to be included in a work of fiction in the same way sex and violence sometimes are, and even nicer that a publisher agreed."

Kasman wanted to see meatier math in the Cas Russell series, and he got *some* satisfaction when mathematical proof—rather than just supercharged computation—figured into *Null Set* (see `https://bit.ly/2Jw2HqM`). Huang stresses that the mathematics is secondary to the narrative and the characters in her fiction—"I'm trying to tell a good story—while having mathematical fun along the way," she says—but she does promise to reward readers with richer mathematical content as the series progresses. While the third book—*Critical Point*, out in April—is on the lighter side mathematically, a later book has a proof-centric plot (!) and explores the difference between computational skill and aptitude for research. "It also features several more realistic mathematicians, who intentionally contrast with my main character's fantastical brand of using math to kill people creatively," says Huang. "It's going to be the most math-heavy book in the series and, perhaps not coincidentally, my favorite!"

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Credits
Book covers are courtesy of S. L. Huang.
Author photo is by David Gabel.

Excerpts from *Zero Sum Game*:

Cas Russell uses math on the job, yes:
(p. 87) Eighty-seven photos had matched his search, and I took a good minute to scroll through them all, even though I didn't need that long. After all, bone structures are only measurements, and measurements are only math. None of the eigenvectors of the feature sets were even close to Dawna's, but I compared the isometric invariants anyway, delaying the conclusion I already knew was true.

(p. 108) I looked down at the two-story drop below me, equations unspooling in my head, the acceleration of gravity tumbling through every incarnation of every possible assignment of variables, and I flattened my arm against the cinder blocks, forcing friction to delay me the slightest touch. Vector diagrams of normal force and gravitational pull and kinetic friction roared through my senses.

Math is the stuff of Russell's witty banter…
(p. 176) "Everything go smooth?"
"So smooth. Infinite differentiability, in fact," I assured him, maybe just to be a little funny.
He cackled. "I knew I liked you."

…and how she busies her mind (to foil a psychic—read the book!):
(p. 187) …I'd filled my brain with unending computations of the nontrivial zeros of the Riemann zeta function. If that ceased to occupy my full concentration, I threw in constructing a succinct circuit and calculated a Hamiltonian path in it at the same time, and also tried to keep up a run factoring a string of two- and three-hundred-digit numbers, one after the other. It was math—but it was normal, uninteresting math, heavy computations…

Even in a post-gunshot haze, Cas's brain teems with the mathematical:
(pp. 225–6) Time seemed slippery, too much effort to hold on to. Half the time I thought I was awake but then realized reality wasn't Hausdorff, and what kind of topology was I in anyway if Twinkies were allowed? And the totient function was a rainbow, a beautiful rainbow and the greatest mathematical discovery of all time, but if you put a Möbius strip in the fourth dimension could a rabbit still hop down the side?

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