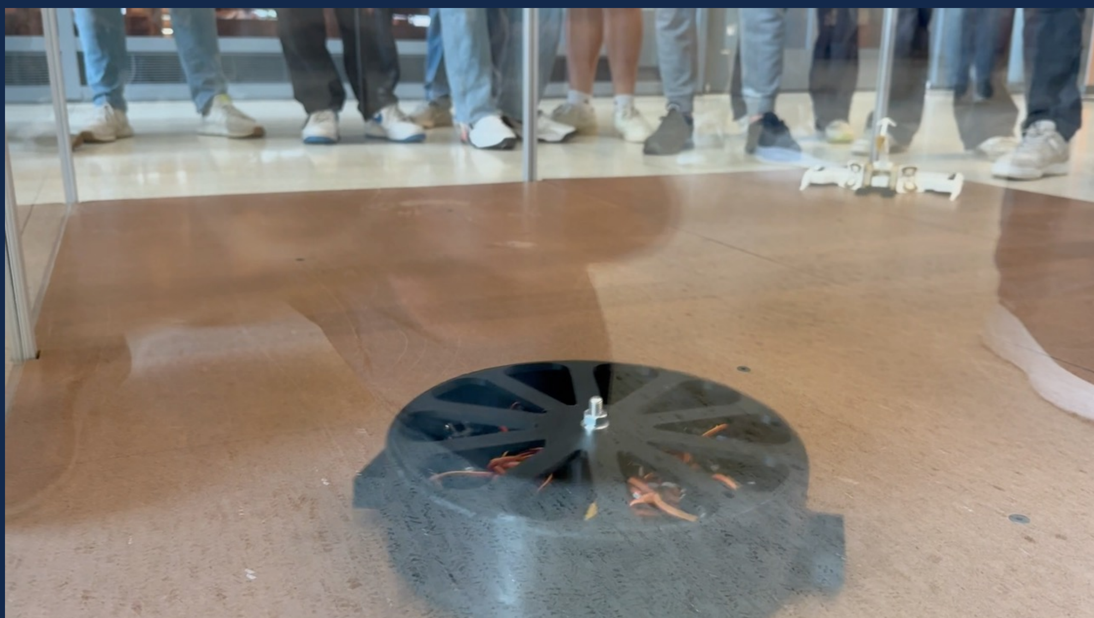
Ant-weight, 3D Printed Battlebots Competition

4–8 teams · bracket competition · $1k first prize

Prof. Viktor Gruev · vgruev@illinois.edu

Two robots. One arena. Two minutes.



From last year's competition, ECEB atrium

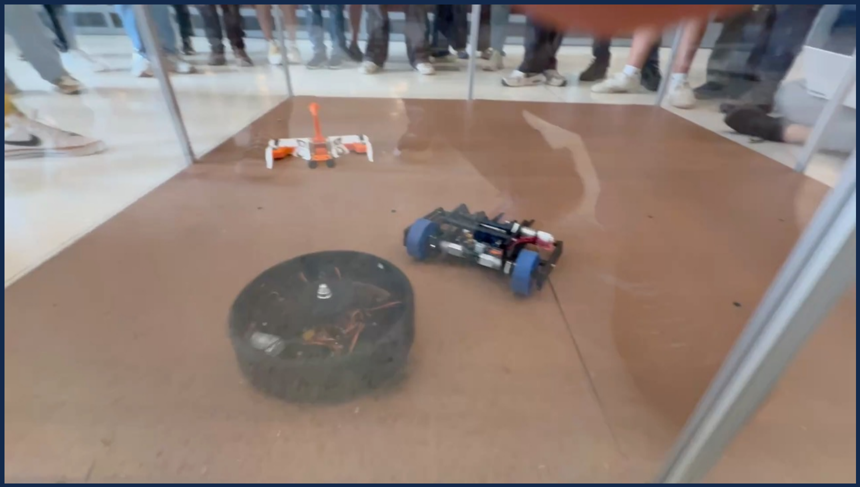
- Under 2 lbs, entirely 3D printed.
- Driven from a laptop over a wireless link you built yourself.
- Custom PCB inside: microcontroller, radio, motor drive, sensors.
- Fighting tool spun by a motor, or driven pneumatically.
- Winner decided on agility, control and damage.

You design, fabricate and debug every part of it.

Robot requirements

Checked at inspection before your first match.

- Under 2 lbs, 3D printed any material.
- Walking robots can be up to 3 lbs.
- A custom PCB housing the microcontroller, Bluetooth or wifi, an H-bridge for motor control, and your sensors.
- Controlled from the PC. No external remote-controlled receiver is allowed.
- Fighting tool activated by motors or by air pressure.
- Easy manual shutdown, and automatic shutdown on loss of the RF link.
- Rules follow thenrc.org, ant weight battlebots section. Detailed specs on the course website.



New this year: every robot streams live sensor data back to the driver station. Next two slides.

Required: camera and time-of-flight, streamed to the PC

Not logged to an SD card. Live, in your driver interface, while you are driving.

Camera

- OV2640 or OV5640 on an ESP32-S3 with PSRAM. Global shutter (OV7251) if motion blur beats you.
- Stream JPEG over wifi: 640×480 at 20–30 fps, roughly 4–8 Mbps.
- It has to render in your driver UI, not just arrive at the PC.
- Report measured latency, camera to screen. Aim under 150 ms.

Watch out: Arena lighting and a crowded atrium wifi band will both hurt you. Test in the room, not at your desk.

Time-of-flight

- VL53L1X: single zone, about 4 m, I²C, 50 Hz. Three or four around the perimeter.
- Or one VL53L5CX for an 8×8 depth map at 15 Hz.
- Overlay the ranges on your video as a proximity ring.
- Report measured range against a dark target and a light one.

Watch out: Every VL53L1X boots at address 0x29. You must sequence the XSHUT pins at startup to reassign them. Plan for it.

Both feeds are what make the sensors real. A number the driver never sees is not doing anything for you.

Alternative: build the weapon ESC

If you would rather do power electronics than vision, this substitutes for the camera requirement.

Three-phase sensored BLDC driver, weapon motor only. Drive motors stay on commercial ESCs, so a board failure costs you a bad match rather than a forfeit.

What you build

- Gate driver with programmable dead-time and overcurrent protection — DRV8323 class. Do not build it from discrete FETs.
- Six-step commutation from three Hall inputs. The logic is a six-entry lookup table.
- Closed-loop RPM plus a current limit for stall detection.
- Report spin-up time and RPM under load.

Where it bites

- Dead-time: hundreds of nanoseconds, or you short the battery through the FETs.
- Bootstrap refresh: you cannot hold 100% duty on the high side.
- Hall-to-phase alignment: twelve combinations, one is correct. A wrong pairing looks exactly like broken code — the motor twitches and gets hot.
- Sensorless back-EMF commutation is out of scope. Do not attempt it.

Competition rules

- We will need at least 4 teams and no more than 8 teams.
- Teams compete for 2 minutes and try to disable each other's robots.
- In the atrium of ECEB, in a specially designed plexiglass arena of 10' by 10'.
- Judging by instructors, peer students, industry partners and alumni.
- Bracket competition. The winner receives an award.
- Final round: all functioning robots compete once more for a special award.

$1k

first place

Questions

Prof. Viktor Gruev
vgruev@illinois.edu

Detailed specs on the course website.