COMBAT BOTS

Joining Instructions & Rules

Release 1 April 2021
Season 1 – 2021/22

The Institution of Engineering and Technology

Young Professionals & OnCampus
Devon and Cornwall

150
1871 - 2021

Combat Bots is a regional robot fighting competition in the Devon and Cornwall Local Network Region. Event organised by the IET D&C YPN.

About

Release 1
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The IET Devon and Cornwall Local Network would like to invite **you** to compete in the 2021/22 regional Combat Bots Tournament.

In the early 2000s, the BBC hosted a cult children's television series Robot Wars. The premise of the show was to have robots – designed by amateur and professional roboteers – fight to the death!

As you can imagine, it was an *instant hit*.

Almost 20 years later, established at the University of Plymouth by Jake Shaw Sutton in 2019, Combat Bots is an extra curricular activity provided for undergraduate and apprentice engineers in the Devon and Cornwall region. You can watch last year's competition here.

The University of Plymouth currently have their own well-established league and **are inviting challengers from industry, other universities and colleges!**

This document will provide your University, College, Team or yourself as an individual everything you need to get involved.

On subsequent pages you should find the following information:

- Timeline.
- Competition Format.
- Rules and Guidelines.
- Hardware Advice.
- Software Advice.

We invite all engineers regardless of age and experience to compete. You may be a junior engineer at a small local manufacturing company, or a senior engineer at an international organisation, or an apprentice at college, or a retired engineer looking to show everyone you've still got it!

The competition will provide an excellent way of networking and demonstrating your technical competencies in a fun and competitive way.

If you have any questions please either email us, or ping us a message in our Combat Bots community on Discord!
samuel.duffield@ietvolunteer.org
https://discord.gg/vW23cDa6A7

DISCORD

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Timeline

Here is our planned timeline. All events prior to December 2021 / January 2022 will be ran virtually to comply with COVID-19 social distancing guidelines. It is hoped that by February 2022, restrictions will be alleviated to allow our first regional final!

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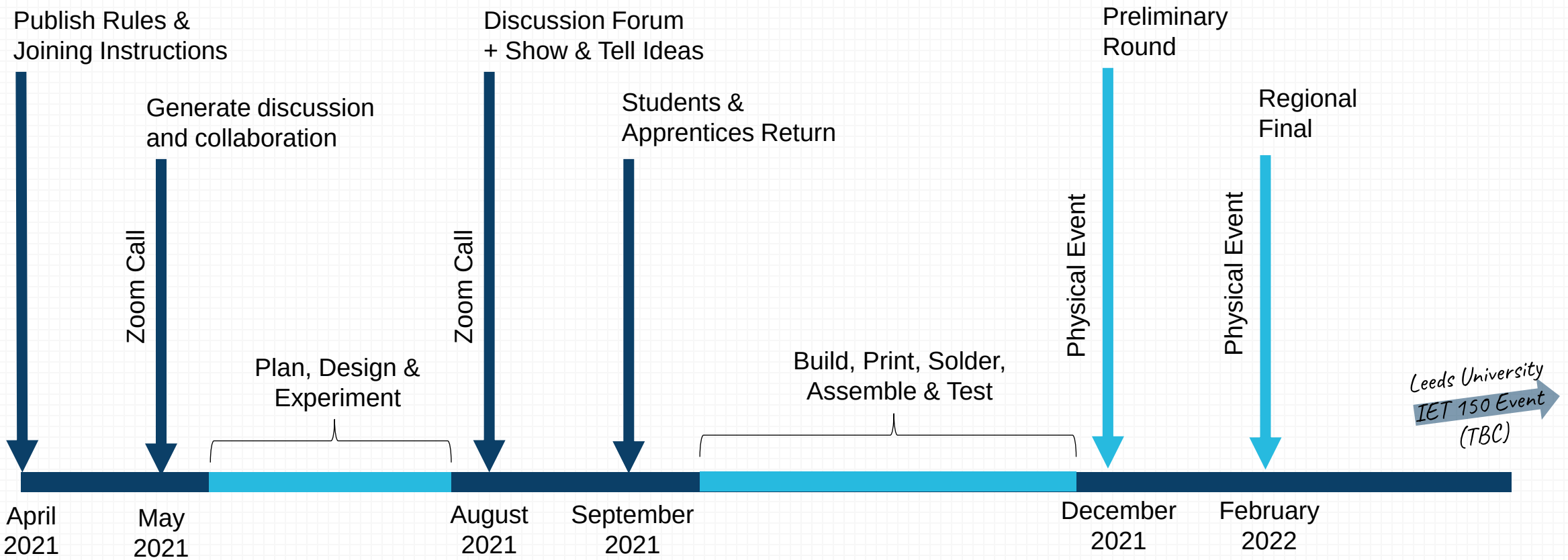

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Quick Start Rules

More detailed rules can be found in this pdf file here.

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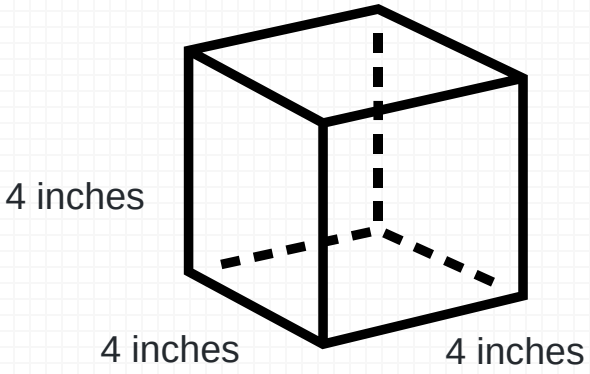

Robots must fit completely inside a

4 inch cube.

It does not have to sit flat on the floor of the cube.

Robots must not weigh more than **150g**.

Robots must have an externally accessible way of being shut down (e.g. a power switch, removable link or battery plug) that can be operated without tools.

The following weapon types are not permitted:

- Glue or sticky pad weapons.
- Fluid based weapons (treacle guns, etc.).
- String or entanglement weapons.
- Flame based weapons.
- The use of electricity as a weapon.
- Explosive weapons.
- Rotating weapons that may shatter (as opposed to - breaking off).
- Magnetic/inductive systems.
- Any system involving the use of pressurised gas or - liquid is limited to 100 psi (7 Bar).

Electronic Warfare (hacking, jamming, intercepting, spoofing communications) is not permitted.

How to Enter

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1. Complete the registration form below to receive email updates and further updates.

Register

Season 1 Deadline - August 2021

2. Join our Discord community to get involved in discussions and share your build!

JOIN OUR SERVER ON DISCORD

3. Share this .pdf with colleagues, friends and on social media to throw the gauntlet down!

ROBOT BUILD TIPS

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Electronics Parts

Below are some electronic parts that we at the IET Local Network, and UoP University students, have experimented with and found to have worked well. You might want to investigate for yourself!

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FlySky FS-i6 i6 2.4G 6CH AFHDS RC Radio Transmitter

Turnigy nano-tech 300mAh battery

FS2A 4CH AFHDS 2A Mini Compatible Receiver

Arduino Nano Every

N20 DC Gear Motor

3pcs H-bridge Stepper Motor Dual DC Motor Driver Controller Board

Turnigy nano-tech 180mAh batteries

DC DC 0.9-6V to 3.3V Auto Buck Boost Step UP Step Down Converter Board

Hardware

We have found in the past that the most robust designs have made use of 3D printing facilities. 3D printing is a rapidly growing hobby and is being widely adopted by industry to accelerate manufacturing times.

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Our favourite printer is the Ender 3 from Creality. It balances performance with cost and is an excellent beginners printer that can offer high accuracy and durable prints.

Find out more about the Ender 3 here.

Not all robots have to be 3D printed! Rango the wedge robot, a 2019 entry, was made from folded sheet metal and featured a cut-out of a Tango can as its flipper!

See more of Rango in action here.

COMPETITION RULES

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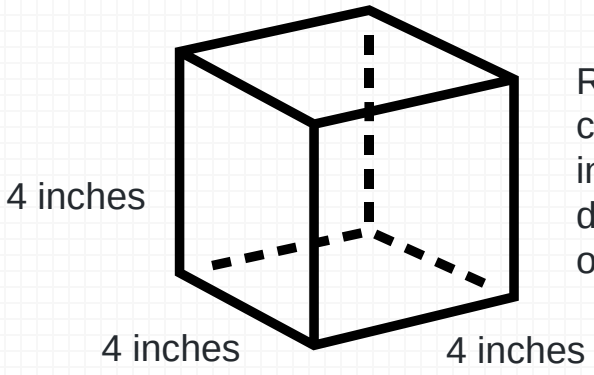
Competition Format

Size, Weight and Power (SWaP)

There are several different weight categories in which robots fight in the UK, across universities and colleges:

- Heavyweight (100kg).
- Featherweight (13.6kg).
- Beetleweight (1.5kg).
- **Antweight (150g).** ←
- Fleaweight (75g).
- Nanoweight (25g).

The University of Plymouth invite challengers in the 150g category. This category was selected to make size, weight and power safely manageable and allow bots to be transported easily.



Robots must fit completely inside a 4 inch (101.6mm) cube. it does not have to sit flat on the floor of the cube.

Robots must have an externally accessible way of being shut down (e.g. a power switch, removable link or battery plug) that can be operated without tools.

For safety purposes, all weaponry must have the capability of being deactivated by remote control.

The robot shall cease all motion when the controlling transmitter is switched off.

The following weapon types are not permitted:

- Glue or sticky pad weapons.
- Fluid based weapons (treacle guns, etc.).
- String or entanglement weapons.
- Flame based weapons.
- The use of electricity as a weapon.
- Explosive weapons.
- Rotating weapons that may shatter (as opposed to - breaking off).
- Magnetic/inductive systems.
- Any system involving the use of pressurised gas or - liquid is limited to 100 psi (7 Bar).

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Competition Format

Safe Practise

Contestants must obey the event organiser at all times, or be disqualified. Event organisers have final say on any issues raised at an event.

There shall be 3 neutral judges identified before each battle. If a contestant has an objection to one or more of the judges, then they shall make it clear before the match begins. The event organisers will then decide if the complaint is valid.

Before competition commences, each robot will be checked by the event organisers to ensure that a minimum of the following rules are complied with before being allowed to compete: weight, size, power link/switch, failsafe, sharp edges.

All teams must be self-contained in terms of driver, transmitter, robots and battery packs, i.e. these cannot be shared with another team. Clusterbots may use additional drivers from other teams but must comply with all other parts of this rule.

Robots should only be handled by the robots' team or event organisers. It is the drivers responsibility to ensure their robot is safe and all weapons are inactive before retrieval.

A robot must be placed in the arena when called to fight within five minutes of being called by the event organiser (this is a maximum limit, contestants are encouraged to be ready to fight as soon as possible). Robots failing to be ready within this time may be judged to have lost the fight.

LiPos must be charged in LiPo bags or a similarly suitable container. They must not be left unattended while charging.

Robots must only be operated inside the arena or normal testing for functionality on a bench. Spinning or otherwise dangerous weaponry may not be used at all outside of an arena with the doors closed.

Non-combatants must not touch the arena and keep back from it during battles.

A LiPo bag or similarly suitable container must be readily available by the arena during each fight.

Competition Format

Combat Rules

Battles will last for a maximum of three minutes. The judges will decide the winner of any battle that has not ended after the time limit.

A robot that falls off the arena and touches the bottom of the pit or dropoff has lost. If a robot bounces into and out of the pit or dropoff without touching the bottom (Or robot that has lost within the pit or dropoff) the fight may continue.

When any robot is immobile or lacks controlled motion then a judge will start a 10 second count down after which the robot will have lost if it is unable to restore controlled motion. Contact between an immobile robot and an opponent will reset the count. If a robot is counted out the immobilisation is retrospectively considered to have applied at the start of the count (For cases where a robot may leave the arena while their opponent is being counted out).

At any time in a fight, a robot may surrender, if so they will have lost (The roboteer may clearly shout stop).

Robots may hold or pin each other for a maximum of 20 seconds. The judge will give a verbal warning for the contestants to disengage. If they are unable to do so the battle will be paused and the robots separated where they are. The battle will then recommence immediately.

Outside manipulation is not permitted during the contest (they may be manipulated by a judge during a pause in the battle, as described in the previous rule).

If a robot leaves the arena after the battle has started but before the robots have made contact the battle is to be restarted. A maximum of 2 restarts is allowed per robot.

The Aggressor Rule – If two robots fall into a pit or dropoff at the same time ending the fight, where one bot can be clearly identified as the aggressor to this action, the aggressor is judged to have won. Normally this occurs where one robot is pushing the other.

If opposing robots have left the arena simultaneously, and a winner cannot be determined as the aggressor, then the fight will be paused, the robots involved placed immediately back in their start positions (without repairs) and the fight restarted. If a robot is unable to continue it will be judged to have lost, if both robots are unable to continue the judges will decide the winner.

Common Sense Winner – If a robot damages another robot, rendering it completely incapable of continuing to fight in any manner (Such as loss of power or no method of any movement), but the damaging robot falls into a pit or dropoff as a result of the attack, as long as the damaging robot is capable of continuing to fight, then the judges may award the damaging robot the win at their discretion.

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ARENA SPECS

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Arena Specifications

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You may wish to construct your own arena to safely test your robot against your friends. **The Combat Bots competition is a high energy and destructive event featuring sharp weapons rotating at high speeds**. Building your own arena is especially important if you are an OnCampus Network at a University and College. Your university or college, will expect its students and apprentices to conduct testing of their Combat Bot in a safe manner on the premises. Students and Apprentices should consult their university of college workshop technical manager, or student union society contact, to clarify the appropriate risk assessment process. Student societies registered as an OnCampus network with the IET are eligible to claim funding toward the build of an arena to safely test their robots.

The Mk1 Combat Bots Arena, designed & built by Jake Shaw Sutton at the University of Plymouth

This is an example arena design! Yours might be more inventive, include or obstacles, or maybe even multiple platforms!

Arena Specifications cont…

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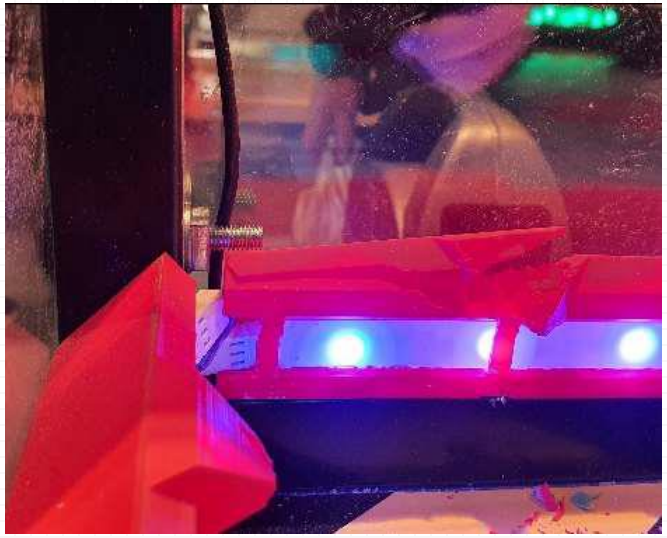
Arena Floor

The floor surface ideally needs to be one that has a high friction to allow robots to grip. It is also recommended to be fire-proof or fire sealed as there may become an occasion in which a Li-Po battery is punctured, and a fire is generated. Fire Retardant Plywood/MDF or with an appropriate sealant coating is recommended with a floor thickness 15+mm. This is because robots with cutting blades or disks may cut deep into the floor.

Arena Enclosure



The Arena wall is recommended to be built up of two stages. An inner layer that will act as a “kick plate” that will be subject to direct high energy impacts. This should be a height of 75mm.

The outer layer of the arena must enclose the entire arena and be made from high strength, transparent, polycarbonate. It must be at least 4mm thick and shock mounted to withstand impact & vibrations

Shock mounting may be achieved through the use of rubber gaskets or grommets purchased from your local DIY store.

Arena Specifications cont…

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Arena Hazards (The Pit)

The pit needs to be large enough for a robot to drop into, without any means of getting out. The pit also must be formed from a strong box in which the robot would fall. Robots that fall into the pit may have high energy weapons and as such the pit needs to be able to resist these impacts. It is recommended for the pit to measure equal or greater than 150mm square. The pit must be activated remotely, either electronically triggered, or by remote latch, to prevent any risk to a user opening the pit.

Fire Suppression

The is a high chance that a battery may be penetrated in a combat bot competition, as such, fire suppressant is required during any operation of the arena or multiple robots. Many robots choose to use Lithium battery packs. These batteries can leak electrolyte if punctured and this consists of a lithium salt in an organic solvent (lithium hexafluorophosphate) which is highly flammable. These batteries contain very little, or no metallic lithium and as such a class D fire extinguisher is not required. For best results dowsing a Li-ion fire, use a foam extinguisher, CO_2, ABC dry chemical, powdered graphite, copper powder or soda (sodium carbonate) as you would extinguish other combustible fires. If the fire of a burning lithium-ion battery cannot be extinguished, allow the pack to burn in a controlled and safe way.

Arena Specifications cont…

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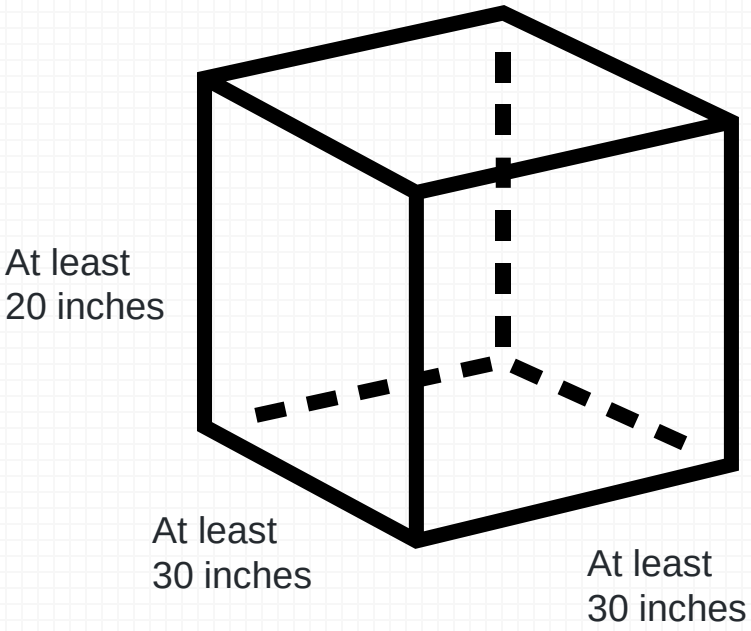
Arena Dimensions



Arena Rules of Operation

All battles must take place in an arena, regardless of weapons being used in the battle.

- Arena doors must be closed before any fight begins, regardless of weapon type.
- An arenas safety enclosure must fully enclose the arena during fights.
- 4mm polycarbonate is the minimum recommended thickness for an arena safety enclosure.
- Small sacrificial kick plates are recommended where the arena fighting surface and external walls meet.
- The arena will be a raised platform with a recommended area of at least 30 inches (762mm) square.
- It is recommended that at least 25% of the edge of the arena must be un-walled, to allow robots to drop directly into the pit or drop off that surrounds the arena.
- The minimum recommended gap in the arena floor for pits and drop offs is 140mm.

Working to engineer a better world