Ant-weight, 3D Printed Battlebot Competition

The objective of this project is to create a battlebot that is remotely controlled from a PC and can compete against other battlebots in a small arena. Each group should should have a unique solution for their battlebot and approach and no two battlebots should be the same.

Here are the specifications of for the battlebot. These specification are similar to the ones found on National Robotics Challenge (https://www.thenrc.org).

Questions regarding this project should be sent to Prof. Viktor Gruev, vgruev@illinois.edu

Plastic Materials

1. PET, PETG, ABS, or PLA, PLA+ are the only materials that can be used for the chassis and fighting tool. You will use these materials to 3D print the battlebot. No other types of plastics or materials allowed (ie. metal, carbon fiber, UHMW, etc)
2. Motors, electronics, axles, fasteners and adhesives can be any material, but cannot be used in such a way to enhance the structural integrity, armor the robot, or enhance any fighting tool.
3. Maximum weight for the robot **2 lb.**

Mobility

1. All robots must have **easily visible and controlled mobility** in order to compete. Methods of mobility include but are not limited to:
    - Rolling (wheels, tracks or the whole robot)
    - Non-wheeled: non-wheeled robots have **no** rolling elements in contact with the floor and **no** continuous rolling or cam operated motion in contact with the floor, either directly or via a linkage. Motion is "continuous" if continuous operation of the drive motor(s) produces continuous motion of the robot. Linear-actuated legs and novel non-wheeled drive systems also qualify.
    - Shuffling (rotational cam operated legs)
    - Other methods of locomotion are not permitted, (hovercrafts, jumping and hopping, flying, etc.)

Robot control requirements:

1. All robots must be controlled via either Bluetooth or WIFI using a microcontroller. A custom PCB will be designed and mounted in the robot. The PCB will house a suitable microcontroller and Bluetooth or WIFI transmitter.

2. The microcontroller will communicate with a PC and the PC will be used to control the robot.
3. The WIFI or Bluetooth connection can be changed or programmed so that it does not interfere with other participants.
4. No read-to-use receiver will be allowed to be used in the robot.
5. If WIFI or Bluetooth connection is lost between the robot and PC, the robot will automatically go into shutdown mode: it will stop moving and the fighting tool will stop rotating.

Batteries and Power

1. The only permitted batteries are ones that cannot spill or spray any of their contents when damaged or inverted. This means that standard automotive and motorcycle wet cell batteries are prohibited. Examples of batteries that are permitted: gel cells, Hawkers, NiCads, NiMh, dry cells, AGM, LIon, LiFe, LiPoly, etc. If your design uses a new type of battery, or one you are not sure about please contact the instructors.
2. The maximum allowed voltage is **16 V**.
3. All electrical power to fighting tool and drive systems (systems that could cause potential human bodily injury) must have a manual disconnect that can be activated within **15 seconds** without endangering the person turning it off. (E.g. No body parts in the way of fighting tools or pinch points.) Shut down must include a **manually** operated mechanical method of disconnecting the main battery power, such as a switch (Hella, Whyachi, etc) or removable link. Relays may be used to control power, but there must also be a mechanical disconnect.
4. All efforts must be made to protect battery terminals from a direct short and causing a battery fire
5. All Robots must have a light easily visible from the outside of the robot that shows its main power is activated. You should also add a secondary light to indicate operational Bluetooth or WIFI connection.

Pneumatics

1. Pneumatic systems on board the robot must only employ non-flammable, nonreactive gases (CO2, Nitrogen and air are most common). It is not permissible to use fiber wound pressure vessels with liquefied gasses like CO2 due to extreme temperature cycling.
2. You must have a safe and secure method of refilling your pneumatic system.
3. We recommends the use of standard paintball fill fittings available at many retail outlets and online. For specs see Part#12MPS from Foster, http://www.couplers.com.

4. All pneumatic components on board a robot must be securely mounted. Particular attention must be made to pressure vessel mounting and armor to ensure that if ruptured it will not escape the robot. (The terms 'pressure vessel, bottle, and source tank' are used interchangeably)
5. All pneumatic components within the robot must be rated or certified for AT LEAST the maximum pressure in that part of the system. You will be required to show rating or certification documentation on ANY component in your system.
6. All pressure vessels must be rated for at least 120% of the pressure they are used at and have a current hydro test date. (This is to give them a margin of safety if damaged during a fight.) If large actuators, lines, or other components are used at pressures **above 250psi** these will also need to be over-rated and are to be preapproved by the instructors.
7. All primary pressure vessels must have an over pressure device (burst/rupture disk or over pressure 'pop off') set to no more than 130% of that pressure vessels rating. (Most commercially available bottles come with the correct burst assemblies, use of these is encouraged)
8. If regulators or compressors are used anywhere in the pneumatic system there must be an (additional) over pressure device downstream of the regulator or compressor set for no more than 130% of the lowest rated component in that part of the pneumatic system.
9. All pneumatic systems must have a manual main shut off valve to isolate the rest of the system from the source tank. This valve must be easily accessed for robot deactivation and refilling.
10. All pneumatic systems must have a manual bleed valve downstream of the main shut off valve to depressurize the system. This bleed valve must be easily accessed for deactivation. This valve must be left OPEN whenever the robot is not in the arena to ensure the system cannot operate accidentally.
11. It is **required** to be able to easily bleed all pressure in the robot before exiting the arena. (You may be required to bleed the entire system if it is believed that you have any damaged components.)
12. All regulated pneumatic systems must have an appropriate gauge scaled for maximum resolution of the pressure on the low-pressure side of the system. HPA (air, nitrogen, or inert gas) systems must have gauges on both the high AND low-pressure sides of regulators. A gauge or other clear visual indication that the system is charged is strongly recommended for all pneumatic systems. Whether specifically required or not.
13. If back check valves are used anywhere in the system you must ensure that any part of the system they isolate can be bled and has an over pressure device.
14. Pneumatic system above 250psi will not be permitted.

Rotational blade

1. Spinning blade that can contact the arena walls above 5 inches from the arena floor during normal operation must be pre-approved by the instructor. (Spinning fighting tools that can contact the arena walls below 5 inches are allowed and do not require prior permission.)
2. Spinning blade must come to a full stop within **60 seconds** of the power being removed using a self-contained braking system.

Springs and flywheels

1. Springs used in robots loaded simply by the weight of the robot (eg. suspension systems) are excepted from the rules in this section. However safe operation and good engineering are always required.
2. Any large springs used for drive or fighting tool power must have a way of loading and actuating the spring remotely under the robot's power.
3. Under no circumstances must a large spring be loaded when the robot is out of the arena or testing area.
4. Small springs like those used within switches or other small internal operations are excepted from this rule.
5. Any flywheel or similar kinetic energy storing device must not be spinning or storing energy in any way unless inside the arena or testing area.
6. There must be a way of generating and dissipating the energy from the device remotely under the robot's power.
7. All springs, flywheels, and similar kinetic energy storing devices must fail to a safe position on loss of radio contact or power.

Competition rules

1. Based on the number of participants, we will form a bracket for the competition.
2. Each competition round will last 2 minutes. The goal is to disrupt the functionality of the opponent's battlebot. The winner will be the battlebot that maintains the most functionality by the end of the 2-minute round.
3. If a battlebot becomes non-functional (e.g., unable to move, though a non-functional fighting tool is not a disqualifier), it will lose that round.
4. If both battlebots become non-functional, the one that stops working first will lose the round.

5. Judges will cast their votes, and based on the scores, a winner will be declared.Any large springs used for drive or fighting tool power must have a way of loading and actuating the spring remotely under the robot's power.

   Here are some example of battlebots using STM microcontrollers.