2026TIRT Lightweight Sumo Robots

Competition Robot Specifications

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I.Educational Objectives:

1. This competition aims to cultivate participants' abilities in structural design, creative assembly, and engineering implementation through the application of modular plastic components.
2. To maintain fairness and educational value, the main structure of the robot shall primarily consist of detachable modular plastic components. The use of specific machining techniques or materials that may create an unfair competitive advantage is discouraged.

II.Main Structural Frame:

The main structural frame of the robot refers to the primary framework that supports the overall body structure, motors, wheel assemblies, and control system. This includes components such as the chassis, motor mounts, control board brackets, and wheel frames.

1. The main structure of the sumo robot shall be constructed using plastic building blocks. Other parts may use composite materials, provided they are also limited to plastic-based materials. Metal components are permitted for joints and load-bearing connections; however, batteries shall not be used for any load-bearing purposes.
2. The main structural frame of the robot must be clearly composed of modular plastic building blocks. The overall appearance and primary load-bearing structure shall demonstrate modular assembly characteristics.
3. Modular plastic building blocks must be assembled using non-permanent connection methods such as pins, snap-fit joints, link rods, or other similar mechanisms. Each structural unit must be detachable and reconfigurable.
4. Metal, carbon fiber, or other high-rigidity materials shall not be used as the primary load-bearing structure. However, they are permitted for auxiliary fastening or connection purposes.

5. If the overall structure or load-bearing configuration clearly does not exhibit modular characteristics, the referee reserves the right to determine, based on the overall design, whether the robot complies with the regulations.

6. Structures constructed using commercially available modular educational building block systems, and which meet the characteristics of being detachable and non-permanently connected, shall in principle be considered compliant with the modular requirements of these regulations.

III.Size and Weight Restrictions:

1. The robot dimensions must comply with the following range:

Length: 15–25 cm、Width: 15–25 cm、Height (including active wheels): 15–25 cm

Any robot with any dimension exceeding the above specified range shall be deemed non-compliant with the regulations.

2. The total weight of the sumo robot (including the battery) shall not exceed 2500 grams (g).

3. Weight measurement shall be conducted during the inspection process before the match. The referee's on-site measurement result shall be considered final and binding.

4. All devices and components participating in the competition (including batteries, sensors, outer casing, and any auxiliary structures) must be included in both weight and dimensional calculations.

5. If any part of the robot detaches during the competition, resulting in an actual weight lower than the inspected weight, the original inspection weight shall still be used as the basis for judgment.

6. The robot shall not be designed with any deformable, extendable, or deployable mechanisms.

7. During the competition, the robot must not actively change its external dimensions. Structural deformation caused by design flaws is also not permitted.

8. If the robot becomes deformed due to collision or external forces, resulting in non-compliance with size or other regulations, the referee reserves the right to determine, based on the severity of the situation, whether it constitutes a violation or warrants disqualification from the competition.

9. Except for the main drive wheel propulsion system, no additional motor-driven mechanisms are permitted on the robot.

10. The above restriction does not apply to sensing devices (e.g., LiDAR or rotary sensors). However, such devices must not affect the outcome of the match or be used as offensive mechanisms.

IV. Motor and Actuation Device Regulations:

1. The sumo robot is only permitted to use motors to drive the main wheels for locomotion purposes.

2. Actuators or power devices referred to in the above rules include, but are not limited to: servo motors, stepper motors, linear actuators, vibration motors, and similar devices.

3. Any passive or active mechanisms that store and release energy to influence the robot's structure, ground contact, or competitive performance are strictly prohibited.

4. Any active motion system that alters the robot's structure, center of gravity, or ground contact is not allowed. This includes, but is not limited to, lifting, pushing, swinging, rotating, deploying, or vibrating mechanisms.

5. Sensors or detection devices (e.g., LiDAR or rotary scanners) that contain built-in motors may only be used for data acquisition purposes. Such devices must not affect robot movement, competitive actions, or match outcomes in any way.

6. The design or use of any power mechanism other than the main drive wheels is strictly prohibited if it is intended to generate impact, pushing force, interference, or any other effect that may influence the outcome of the match.

7. If a device is determined—based on its function or design intent—to circumvent these regulations or to compromise competition fairness, the referee reserves the right to evaluate the robot as a whole. The referee may require modifications or declare the robot non-compliant with the regulations.

V. Controller and Operation Method:

1. Each sumo robot is allowed to use only one microcontroller (single-chip controller) as the primary control unit.
2. The robot must operate in fully autonomous mode. Any form of external control during the competition is strictly prohibited.
3. The use of any wireless communication or remote control systems—wired or wireless—is strictly prohibited. This includes, but is not limited to, infrared (IR), Bluetooth, Wi-Fi, or any other remote control methods.
4. If the controller or any module includes wireless communication capabilities, participants must clearly demonstrate that such functions have been completely disabled. These functions must not be activated during the competition, nor should the system be capable of enabling them during competition.
5. The referee may request functional verification or inspection of relevant devices to determine compliance with these regulations. Participants must not refuse such requests.
6. If a robot is determined to possess remote control capabilities or is found to be designed in a manner that circumvents these regulations, it shall be deemed a violation and may result in disqualification from the competition.
7. After passing inspection, participants are not allowed to perform any parameter adjustments, program modifications, or system setting changes on the robot. They are also prohibited from influencing its operational state by any means. If necessary, the referee may require re-inspection or further checks, which participants must comply with.

VI. 3D Printed Parts Usage Regulations:

If participants use 3D-printed plastic parts, they must comply with the following regulations:

1. 3D-printed components may only be used for auxiliary purposes and shall not form the primary load-bearing structure or chassis of the robot.
2. 3D-printed parts must be modular and detachable. They must be assembled with other components using non-permanent connection methods, such as pins, snap-fit joints, or similar mechanisms.

3. The design purpose of 3D-printed components shall be to assist or extend the functionality of existing modular structures, such as sensor mounts, protective housings, decorative parts, or connection adapters.
4. 3D-printed parts must not be used to create large-scale structures that appear modular in form but are in fact monolithic structures, in an attempt to circumvent these regulations.
5. If 3D-printed parts constitute the main load-bearing structure, chassis, or have a critical impact on the overall rigidity and strength of the robot, they shall be classified as a “3D-printed main structure” and will be deemed non-compliant with the regulations.
6. If 3D-printed parts are used as contact or attack components (e.g., front push plates or shovel-like structures), they may withstand contact and pushing forces during competition. However, the primary structural support and load-bearing function must still be provided by the modular plastic building block structure.
7. If the primary load-bearing structure or functional performance of the robot is clearly dependent on non-modular components, or if there is any suspicion of circumvention of these regulations, the referee reserves the right to evaluate the robot based on its overall design.

VII. Material Usage Restrictions:

1. The main structure of the robot shall not use metal, carbon fiber, or other high-rigidity materials as load-bearing components.
2. A limited amount of metal parts (such as screws, nuts, shafts, etc.) may be used for connection or fastening purposes; however, they shall not serve as primary load-bearing structures.
3. The use of hazardous materials or designs is strictly prohibited. This includes, but is not limited to, sharp edges, brittle or easily fragmented structures, or any components that may cause damage to persons or equipment.
4. The use of highly conductive materials that are exposed externally is prohibited if they may compromise competition safety or cause interference with equipment.

5. The use of magnets or any other adhesive or attraction-based components is strictly prohibited if they affect the robot's ground contact, opponent behavior, or competition results.
6. If any material or design is determined to potentially affect competition fairness or safety, the referee reserves the right to require modifications or declare the robot non-compliant with the regulations.

VIII. Power Supply Regulations:

(The rated voltage of the power supply source shall be used as the unified standard for this competition. Power conversion methods are not subject to restriction.)

1. The total rated voltage of all power sources on the robot shall not exceed 9.0V.
2. Whether using series, parallel, or multi-channel power configurations, all setups must comply with the above voltage limit.
3. During the competition, referees may request participants to power on the microcontroller, power modules, or related devices for inspection. Participants shall not refuse such requests.
4. If a fully enclosed, non-disassemblable commercial battery module is used, its rated voltage must be clearly labeled, and it must still comply with the maximum voltage limit specified in these regulations.
5. If a power configuration is determined to be designed to circumvent these regulations, or if its voltage specification cannot be clearly identified, the referee reserves the right to require modifications or declare it non-compliant.

IX. Inspection and Rule Applicability:

1. If any special materials or designs are used, participants must proactively report and obtain approval from the organizing committee prior to the competition. Any unreported design that is found during inspection or competition to potentially affect safety or fairness may be rejected or required to be modified by the organizers.
2. The organizing committee reserves the right to conduct inspections at any time. This includes on-site examination or necessary testing of the robot's structure, materials, design, or any other elements that may affect fairness or safety.

3. If a robot is determined to violate regulations, contain disputed elements, or attempt to circumvent the intent of the rules, the team must make immediate corrections as instructed. Failure to comply may result in disqualification from the competition.

4. For any unregulated designs or ambiguous cases, the referee shall make the final decision based on the overall structure, functionality, and principles of competition fairness.

5. All functional testing, evaluation results, and inspection procedures of the robot shall be conducted based on the competition venue, testing equipment, and standard operating procedures provided on-site by the organizing committee.

   Participants are not permitted to raise objections based on test results obtained from other environments or under different conditions.

Robot Specification FAQ (Frequently Asked Questions)

I. Overall Design Principles

Q1: What are the main design principles of this competition?

A: The competition is based on three core principles: modular plastic structure, fair competition, and safety. The main structure of the robot should be composed of detachable modular plastic building blocks, and locomotion must be achieved through wheels for competition purposes.

II. Structure and Modularity

Q2: What is a modular plastic structure?

A: A modular plastic structure refers to assemblies constructed using plastic components connected by non-permanent methods such as pins, snap-fit joints, or similar mechanisms. The structure must be detachable and reconfigurable, and should clearly consist of multiple modular units.

Q3: Does the use of commercially available educational building block systems comply with the regulations?

A: Yes. If the system features modularity, detachability, and non-permanent connections, it is generally considered compliant with the regulations.

Q4: Is it considered a violation if the robot appears monolithic in design?

A: If the overall structure or load-bearing configuration cannot be clearly identified as modular assembly, or if the main structure is not supported by modular building blocks, the referee reserves the right to determine compliance based on the overall design.

III. Dimensions and Mechanisms

Q5: Are expandable or deformable mechanisms allowed?

A: No. The robot must not include any deformable, extendable, or deployable mechanisms.

Q6: Does falling parts during the match affect the judgment?

A: The official weight remains based on the inspection record. However, if detached parts affect safety or match progress, the referee may make a situational ruling.

IV. Motors and Power Systems

Q7: Can multiple motors be used?

A: Yes. However, they may only be used to drive the main wheel propulsion system.

Q8: Can motors be used to operate a shovel or other mechanisms?

A: No. Any motor-driven mechanism other than the main drive wheels is prohibited if it affects the outcome of the match.

Q9: Why are additional motor-driven mechanisms not allowed?

A: To ensure fairness and safety, robot interaction must rely solely on wheel-based pushing and movement during competition.

V. 3D-Printed Structures

Q10: Are 3D-printed parts allowed?

A: Yes. However, they are limited to auxiliary use only and shall not be used as the main structure or primary load-bearing components.

Q11: Can 3D-printed parts be used to make shovels or push plates?

A: Yes. The competition allows front-end structures such as shovels or push plates to be used as contact components for pushing and engagement.

Q12: Can 3D-printed shovels withstand pushing forces?

A: Yes. They may withstand contact and pushing forces during competition. However, the primary structural support and load-bearing function must still be provided by the modular plastic building block structure.

Q13: Must 3D-printed parts be fixed to the building blocks?

A: No specific mounting method is required. However, the overall structural support must still be provided by the modular building block system.

Q14: In what cases is a violation determined?

A: If 3D-printed parts form the main load-bearing structure, structural framework, or if the overall strength relies primarily on the printed parts, the robot may be deemed non-compliant.

Q15: How is circumvention of modular requirements determined?

A: If the main structural load-bearing or functional performance clearly depends on non-modular components, or if the design closely resembles a monolithic structure, the referee reserves the right to judge based on the overall design.

VI. Materials and Safety

Q16: Can metal be used?

A: A limited amount of metal is allowed for fastening or connecting plastic building blocks or components. However, metal must not be used as the primary structural element.

Q17: Can magnets be used?

A: No. Any components with magnetic or adhesive properties are strictly prohibited.

Q18: What is considered a hazardous design?

A: Designs with sharp edges, brittle structures, or components that may cause damage to equipment or personnel are considered hazardous. The referee may require modifications or declare such designs non-compliant.

VII. Power Supply and Batteries

Q19: How is the voltage limit calculated?

A: The total rated voltage of all power sources must not exceed 9V.

Q20: Can boost converter modules be used?

A: The regulations do not restrict power conversion methods. However, the overall design must not attempt to circumvent the voltage limit, and the referee will make a final determination based on the full configuration.

Q21: Do batteries need labeling?

A: Yes. The rated voltage must be clearly identifiable and must comply with the competition regulations.

VIII. Control System

Q22: What is a "single microcontroller"?

A: It refers to a single control unit with primary computing and control functions, responsible for the overall operation and decision-making of the robot.

Q23: Are multiple controllers or control boards allowed?

A: No. Devices with independent computing or control capabilities that enable distributed control are strictly prohibited.

Q24: Are sensor modules with built-in chips considered controllers?

A: No. If the module is used solely for data sensing, signal processing, or transmission, and does not possess independent control or decision-making functions, it is not considered a controller under these regulations.

Q25: What is considered a violation of the single-controller rule?

A: If the system includes multiple devices capable of independent computation, logical decision-making, or controlling robot behavior, it may be deemed non-compliant.

Q26: Can controllers such as ESP32 with multi-core or communication functions be used?

A: Yes, under the following conditions:
It is used as a single primary control unit only
All wireless communication functions must be disabled
It must not form a distributed control architecture with other devices

Q27: How is compliance determined by referees?

A: Determination will be based on the overall system architecture and operational behavior. If there is any suspicion of distributed control or circumvention of the rules, the referee reserves the right to declare the robot non-compliant.

IX. Competition and Referee Decisions

Q28: How are situations not explicitly covered by the rules handled?

A: The referee will make determinations based on the overall structure, functionality, and principles of competition fairness.

Q29: Can special designs be pre-approved?

A: Yes. Participants are strongly advised to proactively submit descriptions of any special designs to the organizing committee prior to the competition for clarification or confirmation.

Q30: Can referees require modifications or declare violations?

A: Yes. If a design affects fairness or safety, or is suspected of circumventing the regulations, the referee reserves the right to require modifications or declare the design non-compliant.

Conclusion

This competition allows for diverse designs and competitive strategies; however, the primary structure of the robot must still be constructed using modular building blocks. If a design does not explicitly violate any written rule but is found to circumvent the regulations or affect competition fairness, the referee reserves the right to make a final determination based on the overall design.