Ver-22.05.23.

# KRL - Humanoid Battle

## 1. Description

KRL 「Humanoid Battle」 is a match that utilizes humanoid robots in diverse methods. It is a festival that everyone can enjoy together and emphasizes to respect one another, and to learn each other's skills. It is a 1:1 or 2:2 tournament match that takes place at a designated stadium. The team that acquires a certain amount of point by pushing the opponent or their avatar off the stage wins the game. The competition's league will be divided according to the age of the participant and the weight class of the robot.

※ The tournament schedule can be altered depending on the number of participants.

## 2. Participant Classification

### 2-1. League Class

| Weight Class | Junior Class | Pro Class |
|---|---|---|
| MINIMUMWEIGHT | Age 7 ~ 15 | X |
| FLYWEIGHT | Age 7 ~ 15 | X |
| FEATHERWEIGHT | Age 7 ~ Adult | X |
| BANTAMWEIGHT | Age 7 ~ Adult | |
| LIGHTWEIGHT | Age 7 ~ Adult | Age 13 ~ Adult |
| MIDDLEWEIGHT | X | Age 7 ~ Adult |
| HEAVYWEIGHT | X | Age 7 ~ Adult |

### 2-2. Weight Class

| Weight Class | Criteria |
|---|---|
| MINIMUMWEIGHT | Retail or DIY robots, weight ≤ 0.7 kg |
| FLYWEIGHT | Retail or DIY robots, weight ≤ 0.9 kg |
| FEATHERWEIGHT | Retail or DIY robots, weight ≤ 1.5 kg |
| BANTAMWEIGHT | Retail or DIY robots, weight ≤ 1.7 kg |
| LIGHTWEIGHT | Retail or DIY robots, weight ≤ 2.0 kg |
| MIDDLEWEIGHT | Retail or DIY robots, weight ≤ 2.5 kg |
| HEAVYWEIGHT | DIY robots, weight ≤ 3.3 kg |

2-2-1. Excess weight of up to + 3g is allowed.

### 2-3. Ready-made Product Class  Please inquire for other ready-made robots

| Weight Class | Ready-made Products |
|---|---|
| MINIMUMWEIGHT | Withinno Huro |
| FLYWEIGHT | LINE-Core m, ROBOTIS MINI, RQ-HUNO ect |
| BANTAMWEIGHT | ROBOTIS ENGNEER MAX-E1, MF-17ST, 5720T-FMT, IRH-100, ROMANBO Tonybot |
| FEATHERWEIGHT | ROBOTIS ENGNEER MAX-E2 |
| LIGHTWEIGHT | STEAMCUP PREMIUM, ROBOTIS GP, TINYWAVE, TINYWAVE F, TINYWAVE AF ROBOTIS ENGNEER MAX-E2, VH-19 IMMOTAL |
| MIDDLEWEIGHT | KHR-3HV, PLUTO ect |
| HEAVYWEIGHT | – |

**2-3-1.** "Ready-made products" can participate at the appropriate weight class regardless of the robot's dimension. 'Ready-made products' should have all of the components at the intial state. The use of components from several "Ready-made products" are prohibited; only components from a single product is allowed. However, batteries, battery cases, cables, communication modules, and decorations pieces from other products that does not affect the performance can be used. If any other parts that are not listed above is combined or arbitrarily modified or processed, the robot will be subjected to the DIY category and can only be modified within the Robot Standards policy.

## 3. Robot Standards

### 3-1. Basic Platform

- Humanoid robots that have structures the same as that of humans, such as head, torso, arms and legs and those that meets the "Robot Standards" regulation are qualified to participate.

### 3-2. Robot Standards

**3-2-1.** Overall Size : Distance from the "Top of the Head" to the "Tip of the Toe".

| Weight Class | Height Limitations |
|---|---|
| MINIMUM | under 300 mm |
| FLYWEIGHT | under 300 mm |
| BANTAMWEIGHT | under 400 mm |
| FEATHERWEIGHT | under 400 mm |
| LIGHTWEIGHT | under 400 mm |
| MIDDLEWEIGHT | under 500 mm |
| HEAVYWEIGHT | under 500 mm |

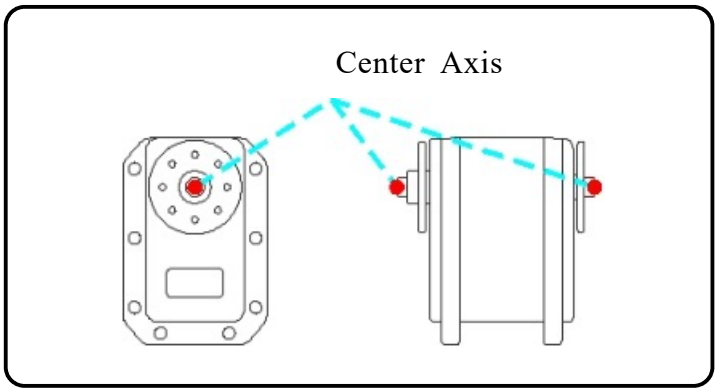
**3-2-2.** Upper-body length : Distance from the "Shoulder Axis" to the "Joint Axis" of the femur structure of the legs closest to the chest structure.

| Weight Class | Upper-body Length Limitation |
|---|---|
| MINIMUM | over 90 mm |
| FLYWEIGHT | over 90 mm |
| FEATHERWEIGHT | **over 100 mm** |
| BANTAMWEIGHT | **over 100 mm** |
| LIGHTWEIGHT | over 100 mm |
| MIDDLEWEIGHT | over 120 mm |
| HEAVYWEIGHT | over 130 mm |

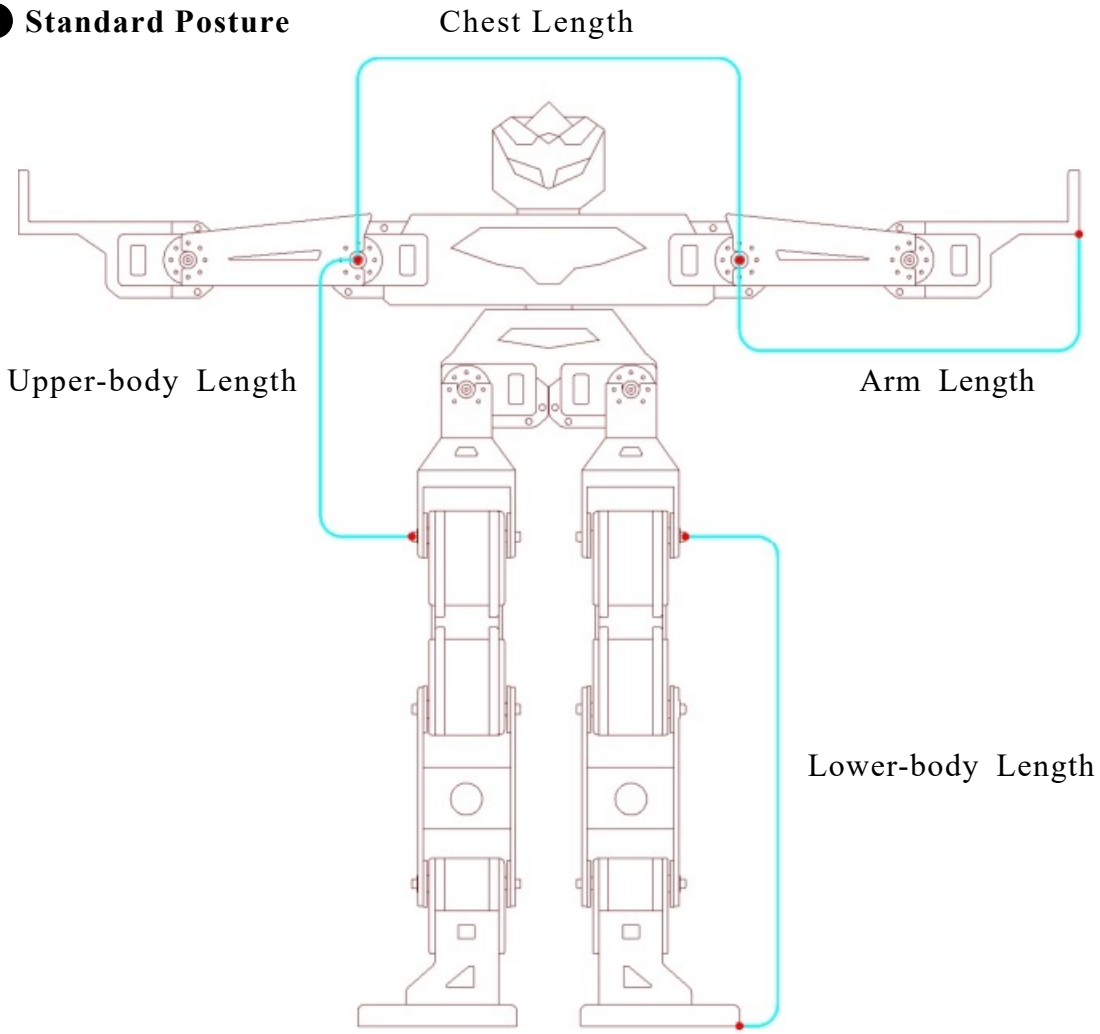
**3-2-3.** Lower-body length : Distance from the "Joint Axis" of the femur structure of the legs closest to the upper-body, to the "Tip of the Toe". However, in case the structure of the legs is a link structure, then the distance is measured as a straight line from the uppermost "Joint Axis" where the motor is directly connected with the link, to the "Tip of the Toe".

| Weight Class | Lower-body Len. Lim. | Leg Width Lim. (Front View) | Leg Width Lim. (Side View) |
|---|---|---|---|
| MINIMUM | 110~140 mm | under 70 mm | under 70 mm |
| FLYWEIGHT | 110~140 mm | under 70 mm | under 70 mm |
| BANTAMWEIGHT | **180~230 mm** | **under 100 mm** | **under 100 mm** |
| FEATHERWEIGHT | **180~230 mm** | **under 100 mm** | **under 100 mm** |
| LIGHTWEIGHT | **180~230 mm** | **under 100 mm** | **under 100 mm** |
| MIDDLEWEIGHT | 230~270 mm | under 110 mm | under 110 mm |
| HEAVYWEIGHT | 270~300 mm | under 110 mm | under 110 mm |

**❶ Standard Reference Point**



❷ **Standard Posture**



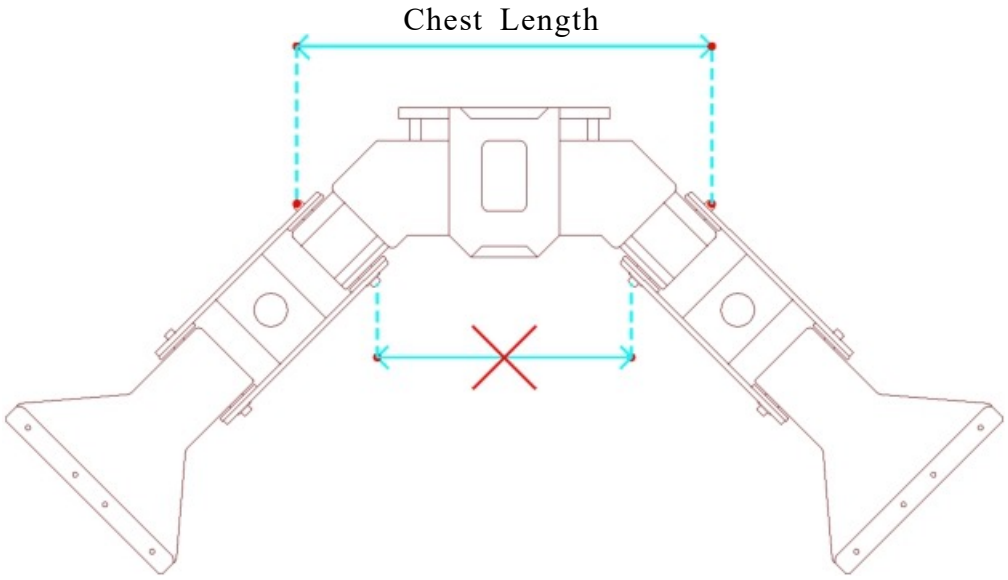

**3-2-4.** Chest Length : Distance between the two outermost “shoulder axis”.

| Weight Class | Chest Length Limitation |
|---|---|
| MINIMUM | under 100 mm |
| FLYWEIGHT | under 100 mm |
| BANTAMWEIGHT | under 120 mm |
| FEATHERWEIGHT | **under 120 mm** |
| LIGHTWEIGHT | under 120 mm |
| MIDDLEWEIGHT | under 160 mm |
| HEAVYWEIGHT | under 180 mm |

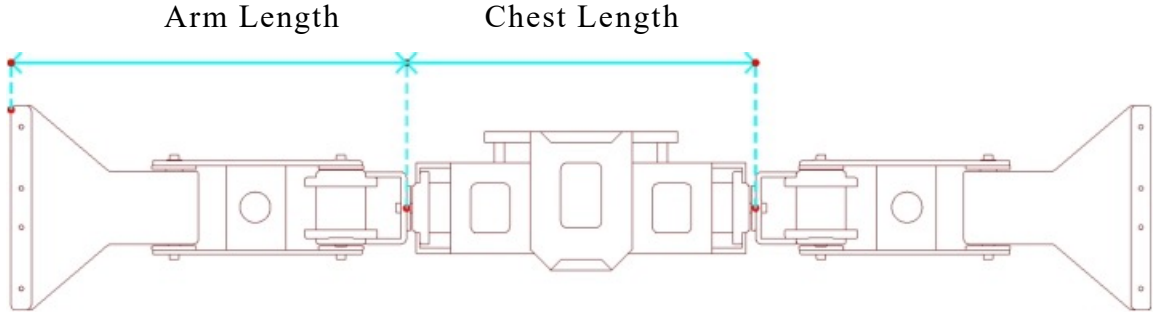
**3-2-5.** Arm Length : Distance from the “shoulder axis” adjacent to the chest, to the tip of the finger.

| Weight Class | Arm Length Limitation | Arm Width Limitation |
|---|---|---|
| MINIMUM | under 160 mm | under 60 mm |
| FLYWEIGHT | under 160 mm | under 60 mm |
| BANTAMWEIGHT | under 200 mm | under 60 mm |
| FEATHERWEIGHT | **under 200 mm** | **under 560mm** |
| LIGHTWEIGHT | under 240 mm | under 60 mm |
| MIDDLEWEIGHT | under 250 mm | under 80 mm |
| HEAVYWEIGHT | under 260 mm | under 100 mm |

**Chest Length**




**Chest Length & Arm Length**

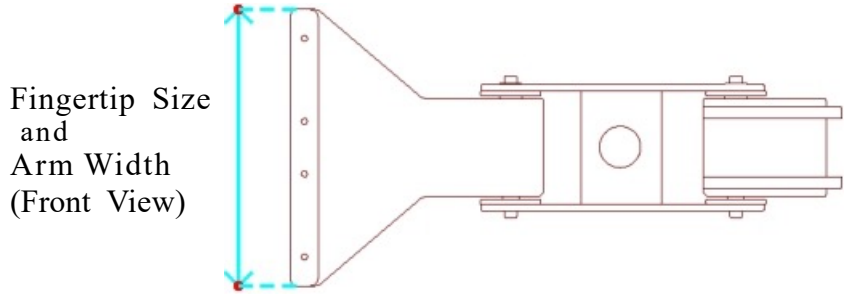



**※ In case of special structures, please inquire by mail with a photo attached.**

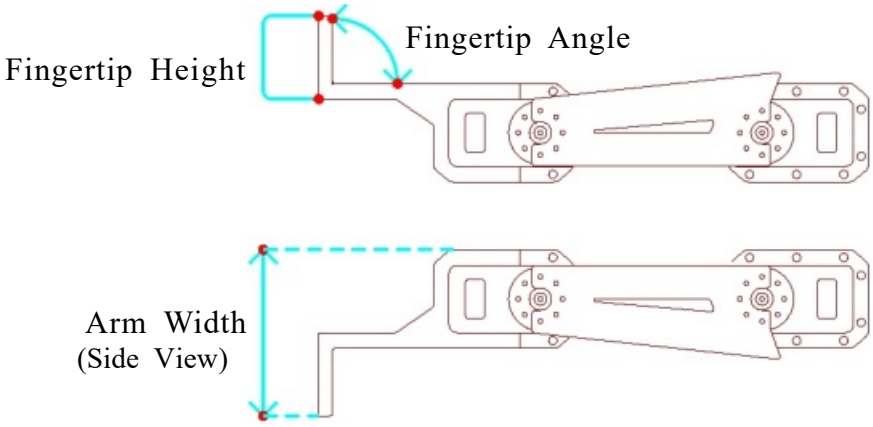
**3-2-6.** Fingertip Size : Length of the fingertips that can attack the opponent robot. When using a gripper, participants can freely use it if each of the "four fingertips" satisfies the standards of the regulation.

| Weight Class | Fingertip Size Limitation | Fingertip Height Limitation | Fingertip Angle Limitation |
|---|---|---|---|
| MINIMUM | under 60 mm | under 30 mm | over 90° |
| FLYWEIGHT | under 60 mm | under 30 mm | over 90° |
| BANTAMWEIGHT | under 60 mm | under 30 mm | over 90° |
| **FEATHERWEIGHT** | **under 60 mm** | **under 30 mm** | **over 90°** |
| LIGHTWEIGHT | under 60 mm | under 30 mm | over 90° |
| MIDDLEWEIGHT | under 100 mm | under 30 mm | over 90° |
| HEAVYWEIGHT | under 100 mm | under 30 mm | over 90° |

**Fingertip Size & Arm Width**



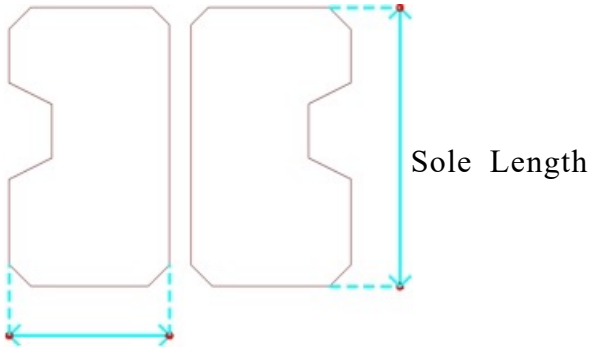

**Fingertip Height & Angle**



**3-2-7.** Sole Size : The maximum length of the width and length of the feet touching the ground.

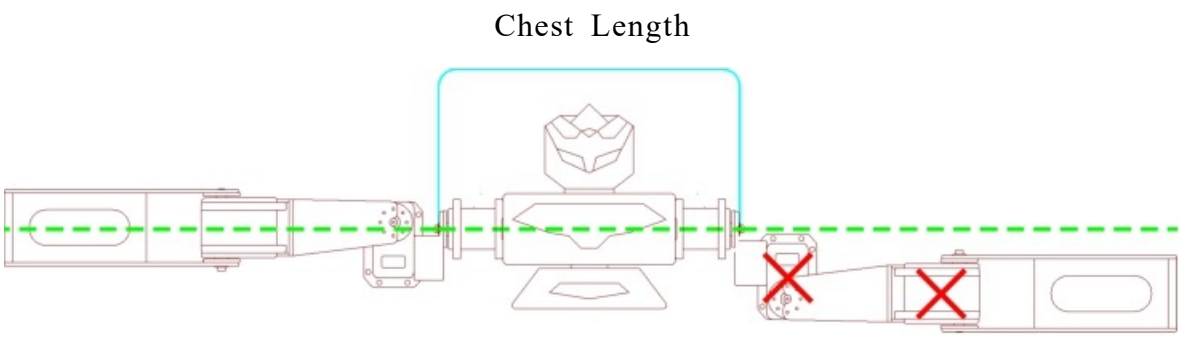
| Weight Class | Sole Length Limitation | Sole Width Limitation |
|---|---|---|
| MINIMUM | under 100 mm | under 60 mm |
| FLYWEIGHT | under 100 mm | under 60 mm |
| BANTAMWEIGHT | **under 105 mm** | **under 65 mm** |
| FEATHERWEIGHT | **under 105 mm** | **under 65 mm** |
| LIGHTWEIGHT | under 110 mm | under 70 mm |
| MIDDLEWEIGHT | under 120 mm | under 76 mm |
| HEAVYWEIGHT | under 130 mm | under 80 mm |

❼ **Sole Size**




**3-2-8. Arm Motor Position** : In the "Standard Posture", with both arms in a horizontal position, all the motors of the arms should be aligned with the shoulder axes. As in the diagram ❽, the motors should not leave the axes due to the rotation of the shoulder axis.

❽ **Arm Motor Position**




Arm motor position regulation VIOLATED

### 3-3. Other Regulations and Assembly Conditions

**3-3-1.** Participants should pre-assemble their robot according to the regulation.

**3-3-2.** In the event in which the robot malfunctions before the match, the participant is given 'two minutes' of time to replace and fix the parts depending on the referee's judgment.

**3-3-3.** Material Surface Treatment Regulations

- For the robot hand part, it is prohibited to use materials that are not anodized (e.g. conductive materials, ect), there should be no parts which are sharp enough or pointed that may lead to injuries. The tip of the hand or the folding sections of the joints should be made round and its form should be kept during the entire match.

If adhesion material is used on the surface of the robot, including the tires, the use is permitted only in the case when the A4 paper, which will be attached and removed from the adhesive part, is not damaged or when there is no residual substances left on the paper.

**3-3-4.** Other Robot Restrictions

- Robots that use structures that include sharp or pointed structures, knives, saw blades, high-speed rotation devices, lasers, electric shock devices, adhesion structures, launch mechanisms or utilizes liquid or flame cannot participate. In addition, robots that can give excessive damage to people, instruments, and stadiums are not allowed to participate.

### 3-4. Wireless Standards

**3-4-1.** All wireless communications are allowed, except wired-communication However, the use of wireless communications may be prohibited if it intentionally interferes with the opponents operation.

### 3-5. Power Regulations

**3-5-1.** Batteries that are on the market, and are guaranteed of safety is allowed. However, the use of AC voltage, liquid fuel and combustion engine is not permitted in consideration of safety.

**3-5-2.** Other than batteries commercially available, self-assembled and refurbished batteries are not allowed.

**3-5-3.** For the safety of the participants, the use of bloated batteries are prohibited.

**3-5-4.** If a participant requires to charge its batteries at the stadium, only chargers equipped with "Balance Charge" function are allowed for use. Chargers that does not meet with this standards cannot be used within the stadium.

**3-5-5.** When charging or storing batteries, all participants should place it inside a Li-Po guard safe bag.

**3-5-6.** The battery must be placed in the safest place inside the robot's upper body.

**3-5-7.** Batteries mounted on the robot should be covered with a "safety cover" in case of damage, and the "safety cover" should be made to be easy removed in case of emergency.

**3-5-8.** If there is a problem with the battery installed in the robot, the robot can be immediately taken out and discarded for safety. All responsibilities rests with the participant for the case above.

**3-5-9. Charging batteries is only allowed in designated places, and all participants should never charge batteries on the floor. When charging on the desk, make sure to double pack the "Li-Po Guard Safe Bag" before charging. If possible, all participants are strongly recommended to wear safety goggles in the event of charging batteries.**

❾ **Li-Po Guard Safe Bag**


## 3-6. Motor Regulations

**3-6-1.** Motor Torque Limitations **※ Please inquire for other types of motors**

: Stall torque at 11.1~12V 1.5A.

| Weight Class | Stall torque | Motor Type |
|---|---|---|
| MINIMUM | under 0.3 N·m | TBA |
| FLYWEIGHT | under 0.5 N·m | LSM-micro, XL-320, SAM-3 ect |
| BANTAMWEIGHT | under 1.5 N·m | Including flyweight motors, WCK-1108T, WCK-1111T, MRS-D2009SP, IRS-430, XL330, XC330, XL430, 2XL430 |
| **FEATHERWEIGHT** | **under 1.5 N·m** | **all motors allowed under the FLYWEIGHT class, WCK-1108T, WCK-1111T, MRS-D2009SP, IRS-430, XL430, 2XL430 ect** |
| LIGHTWEIGHT | under 1.9 N·m | **all motors allowed under the FEATHERWEIGHT class, AX-12A, AX-18A, XC430 ect** |
| MIDDLEWEIGHT | under 6.0 N·m | **all motors allowed under the LIGHTWEIGHT class, MX-28, MX-64, XM430, XH430 ect** |
| HEAVYWEIGHT | under 8.4 N·m | **all motors allowed under the MIDDLEWEIGHT class, MX-106, XM540, XH540 ect** |

### 3-7. Robot Standards Evaluation Process

**3-7-1.** All robots participating in the competition must complete the "standards evaluation" within the specified time. Participants that fail to meet the standards will be disqualified according to the regulations.

**3-7-2.** If a robot needs to be modified or corrected after the 'standards evaluation', it should be re-evaluated after the modification within the specified time. Failure to do so will result in disqualification.

**3-7-3.** For quick and accurate evaluation, during the "standards evaluation", power should be applied and the "standard posture" must be taken in a fixed state. [Refer to "❷ Standard Posture"]
At this time, the participant is responsible for the numerical error that occurs when the robot is not fixed. Bring a remote controller if necessary.

## 4. Match Regulations

### 4-1. Competition Method

**4-1-1.** The participant who gains a greater number of points by "Down" within 2 minutes (Extra 1 minute for overtime match) will win by decision.

**4-1-2.** In the case where a participant gains 5 "Down" points, "TKO Victory" is declared and the match will be immediately terminated.

**4-1-3.** In the case of "Disqualification" or "Absence", the match ends immediately, and the corresponding player is declared as defeat.

### 4-2. Ring Out Regulations

**4-2-1.** If the "robot" falls out of the stadium, it is marked as "Ring Out".

**4-2-2.** If the "avatar" falls out of the stadium, it is marked as "Ring Out".

### 4-3. Down Regulations

**4-3-1.** **'The absolute authority of the judgment and standards of a "Down" declaration lies to the referee.**

**4-3-2.** If a robot is "Ringed Out", one "Down" is marked.

**4-3-3.** **If robots from both teams are to be "Ringed Out", then only the robot that first becomes "Ringed Out" will be marked one "Down". In the event that "robots" from both teams are "Ringed Out" simultaneously and if it is not possible for the referee to decide which team has fallen of the stage first, then both teams will be marked with one "Down".**

**4-3-4.** If an avatar is "Ringed Out", two "Down is marked.

**4-3-5.** **If avatars from both teams are to be "Ringed Out", then only the avatar that first becomes "Ringed Out" will be marked with two "Down". In the event that "avatars" from both teams are "Ringed Out" simultaneously and if it is not possible for the referee to decide which team has fallen of the stage first, then both teams will be marked with two "Down".**

**4-3-6.** **In the event that "avatars" and "robots" from both teams are "Ringed Out" simultaneously and if it is not possible for the referee to decide which team has fallen of the stage first, then both teams will be marked with two "Down" for the "avatars" and one "Down" for the "robots".**

**4-3-7.** Participants that touches his or her robot that is about to fall before it is “Ringed Out” will be marked with one “Down”. If you touch the avatar, it will be marked with two “Down”.

**4-3-8.** Each participant’s “First Warning” is addressed by a verbal warning, followed by one “Down” for every “accumulate” warnings afterwards..

### 4-4. Slip Down Regulations

**4-4-1.** **All parts except for the robot’s feet must not touch the floor of the stadium. If violated, “Slip-Down” is declared. During the 「Humanoid Avatar」 match, there will be no declaration of “Slip-Down” or “Standing Down”. However, if the participant attempts to intentionally pose a “Slip-Down” at the start of or when resuming the match where all robots should be standing upright, then a warning is given.**

**4-4-2.** Even if a “Slip-Down” occurs, the match will continue and it is also possible to pose an attack to the robot fallen down.

**4-4-3.** ‘Even if a “robot” is knocked down due to an accurate attack, if the robot is not “Ringed Out. it is not marked as a ”Down“.

### 4-5. 타임 규정

**4-5-1.** During the match, the competitor may request a “Time-out” from the referee in the event of a rule violation or robot malfunctions. “Two minutes” will be given for all participants and in cases when a participant exceeds the time limit, one “Down” is declared for every excessive “two minutes”

**4-5-2.** Time-out can only be requested just before resuming the match after the “Down” due to “Ring Out”. No “Time-Out” requests will be accepted during the match and the match will continue after the “No-Time” declaration.

**4-5-3.** ‘Time-out’ requests made due to objections or for making critical suggestions during the competition will not be declared as one “Down”. However, a “warning“ is imposed if it is not accepted as a reasonable ”Time-out“ by the referees’ judgment.

### 4-6. Standing Down Regulations

**4-6-1.** During the 「Humanoid Avatar」 match, “Standing Down” will not be declared.

### 4-7. KO Regulations

**4-7-1.** During the 「Humanoid Avatar」 match, “KO” will not be declared.

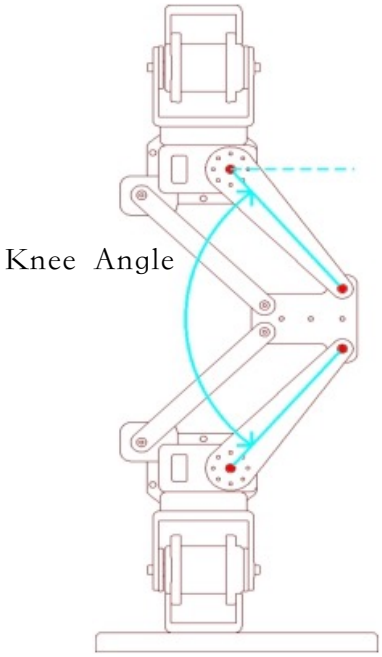
### 4-8. Defense Posture Regulations

**4-8-1.** “The angle of the knee” (angle between the thigh and the calf relative to the knee) should be “at least 100°”. Any angle below shall be assumed as a “Defense Posture”.

**4-8-2.** If the “axis of the shoulder” is lowered to the lower-body, then it is assumed the robot has taken a “Defense Posture”.

**4-8-3.** During the 「Humanoid Avatar」 match, "Defense Posture" will not be limited and it is allowed to freely use during the match.

**Knee Angle & Standard point for Upper/Lower-body**
**- NO LIMITATION**




## 4-9. Attack Regulations

**4-9-1.** Any attacks in all "360° " directions are permitted.

## 4-10. Critical Down Regulations

**4-10-1.** In the 「Humanoid Avatar」 match, if the participant is able to "Ring Out" the opponent's "avatar", it is judged as a "Critical Down" and two "Down" will be marked.

## 4-11. Walking Regulations

**4-11-1.** In the 「Humanoid Avatar」 match, it is allowed to walk in the "Defense Posture".

**4-11-2.** **In the "Slip Down" state, it is not allowed to move lying down such as crawling which is not an ordinary state of walking. Violation of this article will result in a "warning".**

**4-11-3.** It should be possible to walk without falling "at least 5 steps in two directions" out of the four directions (front, rear, left, and right). The referee may request confirmation at any time before or during the match, and participants with robots that fails to meet the condition above will be disqualified.

## 4-12. Other Regulations

**4-12-1.** At the beginning of the match, or after the match is resumed after a "Down" is declared, all robots are to be positioned at the start position. The start distance between the robots should be at least 30

cm apart. In case a participant intentionally violates this article are imposed a “warning” from the referee. In the FLYWEIGHT class, the distance is 15 cm apart

**4-12-2.** During the match, if the battery of the robot falls apart from the body, the match will be suspended immediately. Afterwards, the corresponding participant is given “two minutes” of repair time and a “Down” will be marked. If the repair is not possible, a “TKO defeat” will be declared.

**4-12-3.** During the match, the robot cannot be touched without the permission of the referee. Participants that fail to do so will be imposed a “Down”.

**4-12-4.** If a defensive game is played, the referee can impose a “warning”. **4-12-5.** In case of a “stop” sign from the referee during the match, both participants should stop their robots immediately. Violation of this article may result in a “warning”.

**4-12-6.** “Torque-Off” may be declared if robots are tangled to each other, and participants must immediately cut off the power applied to the motor.

**4-12-7.** If an error or misjudgment is made by the referee, a rematch may be proceeded during the match or even after the match has finished.

**4-12-8.** If the competitor or their parties does not comply with the referee’s decision, or give a remonstrance with an impolite manner, a “warning” will be given. If this is repeated even after the warning, the corresponding participant will be immediately disqualified.

**4-12-9.** In the event when a referee explains about the decision or rule, during the match or while the match is suspended, participants are required to reply “Yes” with a “nod” as a means of understanding the decision or rule.

**4-12-10.** If a participant intentionally lied in front of the “avatar” and delays the match, the match can be immediately suspended and the corresponding participant will be given a “warning”. Then determined by the referee’s decision, the match will resume at the start position or from the state where the match was suspended.

**4-13. Term Regulations**

**4-13-1.** While the match, terms as ‘레디:Ready’, ‘파이트:Fight’, ‘다운:Down’, ‘노카운트:No-Count’, ‘스탠딩다운:Standing-down’, ‘링 아웃:Ring-out’, ‘토크오프:Torque-Off’, ‘떨어져:Tteol-eo-jyeo(Distance)’, ‘경고:Yellow-Card’, ‘타임:Time’, ‘스톱(중지):Stop’, ‘그만:Geu-man(Game-Over)’, ‘승:Seung(Win)’, ‘차렷:Cha-lyeos(Attention)’, ‘인사:In-sa(Bow)’ ect will be used. All participants should be familiar with the terms that will be used according to the situation.

**4-14. Other matters not presented shall be decided upon consultation with the Referee Committee on the same day.**

## 5. Robot Modification Regulations

**5-1-1.** In the event when a robot needs to be modified after the "Standards Inspection" due to the abnormal conditions of the robot, it must be approved by the referee before it can be modified. (One "Down" will be marked, if needed to be modified during the match.)
If a participant changes the robot arbitrarily without permission, the corresponding participant will be "disqualified".

## 6. Evaluation Method

### 6-1. Basic Evaluation

**6-1-1.** The participant who attains a certain number of "Down", declaration of "TKO" or "win by decision", disqualification or withdrawal of the opposing team shall win the match.

**6-1-2.** Depending on the situation, multiple robots may be put in a "rumble" match as a "Rank Determination Match". In a "rumble" match, it is possible to pose an attack towards a fallen robot, and when other participant's robots are declared "Ring Out" or a "Down", then the robot last standing on the field **or the team that "Rings Out" the "Avatar" wins.**

### 6-2. Tie Regulations

**6-2-1.** In the case of tie, no repair time will be given and both participants immediately start an overtime match of "one minute". In the event of an overtime match, the "warning" received from the official match shall be carried forward to the overtime match.

**6-2-2.** Evaluation Priority : The first to score in the overtime match > The side with less warnings in the overtime match > **The side with less Slip ~~downs in the overtime match~~** > "One minute~~" of an extra overtime~~ match if no results come out down to the wire.

### 6-3. Disqualification Regulations

**6-3-1.** Rejection to the referee's instruction or decision.

**6-3-2.** In case of violation of the "Robot Standards" during the match.

**6-3-3.** If robots that are not of your possession is tampered, or interference of the match.

**6-3-4.** If you leave the stadium or the designated waiting area without the permission of the referee.

**6-3-5.** In case of verbal abuse or conflict among participants.

**6-3-6.** Participating a match with a robot that is used by another participant in the same competition.

**6-3-7.** Cases when other participants suffer loss due to cheating or actions passing the bounds of common sense.

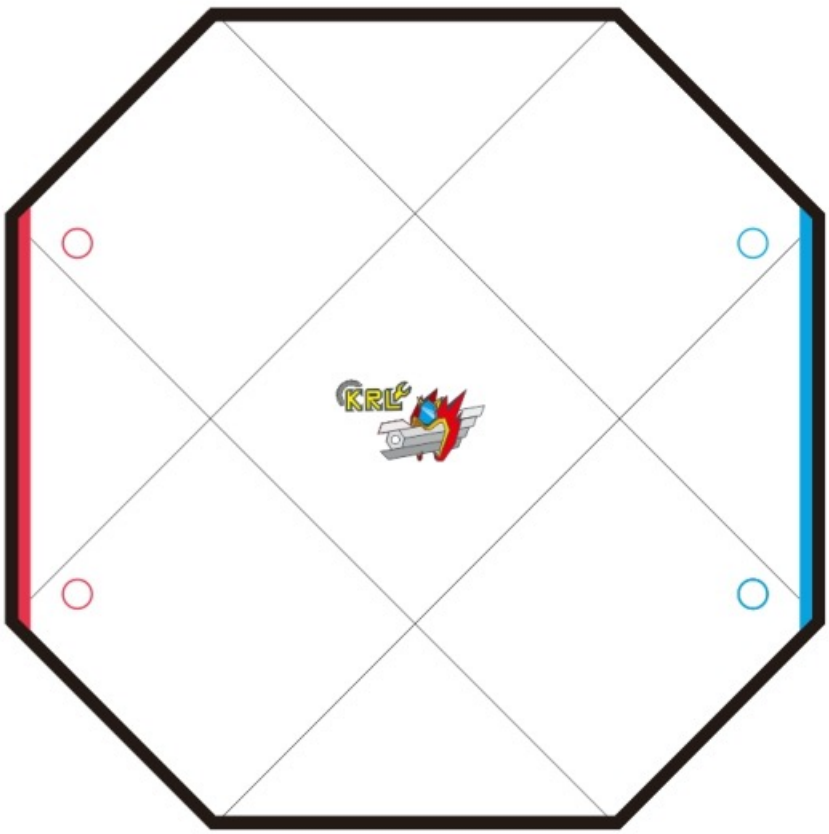
## 7. Stadium Regulations

**7-1. Stadium structure** – This is an example and my change depending on the situation on the day of the competition.

**7-1-1. Stadium size**

- Stadiums for all weight classes except FLYWEIGHT and FEATHERWEIGHT is **198 x 198 x 30 cm (Width x Lenght x Height). (Error Range ±5%) 70 x 70 cm, the stadium will be made with five 22T square plastic-coated laminated wood size of 70 x 70 cm, four 22T right-angled triangle and the stadium floor material is FLEX.**

**Stadium size**



*** The rules of the competition may be updated later. It is strongly recommended to regularly check the updated rule book. ***



IREA International Robotics Educational Association