



Soccer Rules (2013)

P.1

*Note: Changes from 2012 rules are highlighted in red.
Translated by RoboCupJunior Hong Kong*

RoboCupJunior Soccer Rules 2013

RoboCupJunior Soccer Technical Committee 2013:

José Dias (Portugal), jatdias@sapo.pt

Gerard Elias (Australia), elias.gerard@gmail.com

Luis José López (Mexico), CHAIR, llopez@TecnoVanguardia.com

Katsumi Masaoka (Japan), k-mac@sea.plala.or.jp

Sebastian Polly (Germany), Sebastian.Polly@gmx.de

Gio Spina (Canada), profspina@gmail.com

These are the official rules for RoboCupJunior 2013. They are released by the RoboCupJunior Soccer Technical Committee for Soccer. These rules have priority over any translations.

這是RoboCupJunior 2013的官方賽規，由RoboCupJunior足球技術委員會所發佈，本賽規的任何翻譯，如有歧義，一概以英文(原文)為準。

Preface 前言

In the RoboCupJunior soccer challenge, teams of two autonomous mobile robots compete against another team in matches. They must look for an infrared-light-emitting ball, trying to score into a color-coded goal in a special field built in a way that resembles the actual field for human soccer. Robots are required to have full autonomy from humans, technical designs, and ingenious programming by their developers.

在RoboCupJunior足球的競賽中，每隊的兩個自主移動機械人與另一支隊伍比併。機械人必須尋找一個發射紅外線的足球，在一個特製的球場中試圖將足球射入顏色編碼化的球門，球場擬似於真實的人類足球場。機械人必須為全自主的，這來自開發者透過技術設計和巧妙的編程。

Participants of this challenge are required to give the best of their abilities in programming, robotics, electronics and mechatronics, but also to contribute on teamwork and knowledge sharing with other participants, regardless of culture, age or result in the competition. All are expected to compete, learn, have fun and grow up.

對這項挑戰的參加者來說，需要付出他們最大的能力，包括在編程、機械人、電子、機械和電器一體化，並且無論文化、年齡和比賽結果如何，必須在團隊合作、分享知識方面做出貢獻。每個人都期盼競爭、學習、玩得高興趣和成長。

The changes determined by the Technical Committee for this year's rules aimed to favor skills over brute force in the games, with safer conditions for both robots and humans. The rules better work out situations of aggressive robots that cause damage to IR balls, robots and fields; control unrealistic kicker force that cause damage to IR balls and referees; and reduce the excessive need for human intervention in a stressful attempt to maintain game continuity.

今年技術委員會決定對賽規作出改動，目的是使球賽偏重在技術面上而非蠻力，為機械人和人提供更安全的比賽條件。規則更有效解決具侵略性的機械人情況，如損壞紅外線足球、機械人、足球場；控制不合理的踢球力度而導致紅外線足球和裁判受損害；減少過分的人為干預以保持球賽的連續性。

1. TEAM 隊伍

1.1 Regulations 規則

A **team** consists of two or more members. 每隊由兩個或以上的隊員組成。

Each team must have a **captain**. The captain is the person responsible for communication with the referee. A team can replace its captain during the competition. **Team is allowed to have only the fewest possible members beside the field during game play; they will usually be the captain and an assistant team member.**

每隊必須有一名**隊長**。隊長有責任與裁判溝通。比賽期間，隊伍可以更換隊長。球賽期間，每隊只允許盡可能少的成員在球場旁邊：他們通常是一名隊長和一名協助的隊伍成員。

1.2 Violations 違規

Teams that do not abide by the rules are not allowed to participate.

若隊伍不遵守規，不允許參加比賽。



Soccer Rules (2013)

P.2

Note: Changes from 2012 rules are highlighted in red.

Translated by RoboCup Junior Hong Kong

Any person close to the playing field is not allowed to wear any yellow or blue clothes that can be seen by the robots (to avoid interference with the goal colour). A referee can require a team member to change clothes or to be replaced by another team member if interference with goal colour is suspected.

任何人身穿黃色或藍色衣服的人士都不允許靠近球場，因可被機械人看到(避免與球門顏色混淆)。當球門顏色懷疑受到干擾時，裁判可要求隊伍隊員更換衣服或由另一隊員取替。

The referee can interrupt a game in progress if any kind of interference from spectators is suspected (colour clothing, IR emitters, camera flashes, mobile phones, radios, computers, etc.).

如果裁判懷疑任何形式的干擾來自觀眾(服裝的顏色、紅外線發射器、照相機的閃光燈、手機、收音機、電腦等)，裁判可以中斷正在進行的球賽。

2. ROBOTS 機械人

2.1 Number of robots / substitution 機械人/替換數目

Each team is allowed to have at most two robots. A substitution of robots during the competition within the team or with other teams is forbidden.

每支隊伍僅容許擁有兩個機械人。比賽期間，嚴禁隊伍內部或隊伍之間替換機械人。

2.2 Interference 干擾

Robots are not allowed to be coloured yellow or blue in order to avoid interference with the goal colours. Yellow or blue parts used in the construction of the robot must either be covered by other parts from the perception by other robots or be taped/painted with a neutral colour.

機械人不得塗成黃色或藍色，以避免干擾機械人辨認球門顏色。機械人構造上的黃色或藍色部分必須用其他部件遮蓋或塗成另一顏色。

The robot must not emit infrared light. However, **optional sensors (e.g. infrared-distance sensors)** may be used as long as they do not affect other robots. This needs to be proved by a referee or an OC member if a claim is placed by the other team.

機械人不可發射紅外光。然而，**光學傳感器(如：紅外線測距傳感器)**仍可使用，只要它們不影響其他的機械人。這需要由裁判或大會委員會成員證實，如要求放到其他隊伍的機械人前。

Infrared light reflecting materials must not be used on the outside. If robots are painted, they must be painted matte. Minor parts that reflect infrared light could be used as long as other robots are not affected. A team claiming that their robot is affected by the other team's robot reflecting infrared light has to show the proof/evidence of the interference.

外殼不可使用能反射紅外線的物料。如果機械人被塗上顏色，則必須為啞光的。次要的部分為反射紅外線的物料是可用的，只要不影響其他的機械人。隊伍聲稱他們的機械人受其他隊伍的機械人所反射的紅外線干擾時，需要提出受干擾的證明/證據。

2.3 Control 控制

The use of remote control of any kind is not allowed. Robots must be started manually by humans and be controlled autonomously.

禁止使用任何遙控方式操控。機械人必須由人手啟動和自動控制的。

2.4 Communication 通訊

Robots are not allowed to use any kind of communication during game play unless the communication between two robots via Bluetooth class 2 or class 3 (range shorter than 20 meters) or via ZigBee. Teams are responsible for their communication. The availability of frequencies cannot be guaranteed.

比賽期間，不容許機械人使用有任何通訊，除機械人之間透過藍芽Class 2 / 3 (範圍少於20米)或ZigBee通訊例外。隊伍需為他們的通訊負責。頻率的有效性無法獲保障。



Soccer Rules (2013)

P.3

Note: Changes from 2012 rules are highlighted in red.

Translated by RoboCupJunior Hong Kong

2.5 Agility 靈活

Robots must be constructed and programmed in a way that their movement is not limited to only one dimension (that means one axis). They must move in all directions, for example by turning. Robots must respond to a ball in a direct forward movement. For example, it is not enough to basically just move left and right in front of their own goal, but also to move directly towards the ball in a forward movement. **At least one team robot must be able to seek and approach the ball anywhere on the field, unless the team has only one robot on the field at that time.**

搭建及編程的機械人，移動方式不能限於一個維度，機械人必須能夠作各方向活動，如轉向。機械人必須對球作直接向前運動反應。例如：基本上僅於己方球門前左右移動是不足夠，還需要直接朝著球向前運動。**隊中必須至少有一個機械人能夠在球場上任何一處尋找和接近足球，除非當時隊伍只有一個機械人在球場上。**

Robots must be constructed and programmed in a way that they do not enter a goal. Robots are allowed to use their cross-bar.

搭建及編程的機械人必須做到不會進入球門，但容許機械人利用(觸碰)球門的橫樑。

2.6 Handle 把手

All robots must have a stable handle to hold and to lift them. The handle must be easily accessible, for example on top of a robot. The dimensions of the handle may exceed the 22 cm height limitation, but the part of the handle that exceeds this 22 cm limit cannot be used to mount components of the robot.

所有機械人必須有個穩固的把手，以便拿住及舉起它們。把手必須容易使用，例如位於機械人的上方。把手的尺寸可超過22厘米的高度限制，但把手超出22厘米限制的部分是不可用作固定機械人的組件。

2.7 Additional regulations of the sub-leagues 附屬聯盟附加規則

A tournament may be organized in different sub-leagues. Each sub-league (e.g. "Open League" and "Light Weight League") may have its own additional regulations, including regulations affecting the construction of robots. Such regulations will be passed by the RoboCupJunior Soccer Technical Committee and become a part of this rule.

比賽可能由不同的附屬聯盟組成。每個附屬聯盟(例如："公開級"及"輕量級")可能有自己的附加規則，包括規則對機械人構造影響。這些規則都會先經 RoboCupJunior 足球技術委員會通過及成為該規則一部分。

2.8 Violations 違規

Robots that do not abide by the above specifications/regulations are not allowed to play. If violations are detected during a running game the team is disqualified for that game. If similar violations occur repeatedly, the team can be disqualified from the tournament.

機械人不遵從上述規格或規則，不容許參與比賽。球賽進行期間如被判違規，隊伍會被取消該場球賽參賽資格。如疑似違規事件重複發生，隊伍可被取消所有參賽資格。

3. FIELD 場地

3.1 Kinds of fields 場地類型

There is only one kind of field for all sub-leagues.

所有子聯盟都只有一種賽場。

3.2 Dimensions of field 場地尺寸

The playing-field is 122 cm by 183 cm. The field is marked by a white line which is part of the **playing** field. Around the playing-field, beyond the white line, is an outer area of 30 cm width. Total dimensions of the field, including the outer area, are 182 cm by 243 cm. It is recommended that the field be positioned 70 to 90 cm off the ground.

內場區域為122厘米 X 183厘米。內場區域劃上白線的範圍屬比賽場地。圍繞內場區域，即白線以外，為闊30厘米的外場區域。整個場地總尺寸包括外場區域為182 cm X 243 cm。建議放置場地時，離地面高度70至90厘米。

3.3 Walls 圍牆

Walls are placed all around the field, including behind the goals and, if applicable, the out-area. The height of the walls is 14 cm. The walls are painted matte black.

場地的四周，包括球門後方和外場區域都有牆壁。牆壁的高為14cm。牆面塗有啞光黑漆。



Soccer Rules (2013)

P.4

Note: Changes from 2012 rules are highlighted in red.

Translated by RoboCup Junior Hong Kong

3.4 Goals 球門

The field has two goals, centered on each of the shorter sides of the playing field. The goal inner space is 60 cm width, 10 cm high and 74mm deep, box shaped. It has a cross-bar on top (to prevent robots from entering the goal and to allow checking it the ball scored). The goal "posts" are positioned over the white line marking the limits of the field. The cross-bar is exactly over the white line. The interior walls and the cross-bar of each goal are painted, one goal yellow, the other goal blue. The exterior is painted black.

場地有兩個球門，分別位於內場區域底線(窄邊)的中央。球門內部空間為寬60厘米，高10厘米和深74毫米，呈盒狀。上面有橫樑(防止機械人進入球門和用以檢查是否進球)。球門柱位於球場底線的白線上，橫樑準確投映白線上。球門內側的牆壁及橫樑都塗上顏色，一方為黃色，另一方為藍色，球門外側被塗成黑色。

3.5 Floor 地板

The floor consists of green carpet on top of a hard surface. **The carpet should be of a quality that will resist the wear and tear of spinning wheels. All straight line on the field should be painted and have a width of 20mm.**

地板為堅硬的表面上鋪上綠色地毯。地毯的質量應能抵抗車輪旋轉帶來的磨損和撕裂。場地上的直線應是上色和闊20毫米。

3.6 Neutral spots 發球點

There are five neutral spots defined in a field. One is in the center of the field. The other four are adjacent to each corner, located 45 cm along the long edge of the field, aligned with each goal post towards the middle of the field (from the goal post). The neutral spots can be drawn with a thin black marker.

場地定義了五個發球點。其中一個發球點在場地中央。其餘四個發球點位於四個牆角附近，沿著賽場的長邊45cm分佈。同時，發球點與長邊保持一個球門寬的距離，發球點為靠近場地中部且與門柱並排。發球點可以是由幼的黑色雙頭筆油成。

3.7 Center circle 中央圓圈

A center circle will be drawn on a field. It is 60 cm in diameter. It is a thin black marker line. It is there for referees and captains as a guidance during kick-off.

場地上的中央將畫上一個圓圈，為直徑60cm，粗黑線。中央圓圈是輔助裁判及隊長開球之用。

3.8 Penalty areas 罰球區

In front of each goal there is a 30 cm wide and 90 cm long penalty area.

球門前方闊30cm，長90cm處為罰球區。

Penalty areas are marked by a black line of 20 mm width. The line is part of the area.

罰球區邊線為20mm闊的黑線。線屬罰球區一部分。

A robot is considered inside a penalty area when it is completely inside.

機械人於罰球區內是指整個機械人完全在罰球區內。

3.9 Lighting and Magnetic Conditions 照明及磁場

Fields should be placed in a way that influences from external infrared lights and any influences that interfere with the magnetic field of the earth are as minimal as possible. Perfect conditions cannot be guaranteed. Teams must come to tournaments being prepared to calibrate their robots based on the lighting and magnetic conditions at a venue.

大會放置場地時，會盡可能減少場地受到外界紅外線的干擾及盡可能減少受到地球磁場的擾亂。但是，無法保證能做到盡善盡美。參賽隊伍應於比賽前先到比賽場地，準備和調校好自己的機械人，使它能適應場內的照明和磁場。

4. BALL 足球

4.1 General ball specification 一般足球規格

A well-balanced electronic ball shall be used. The ball will emit infrared (IR) light set to pulsed mode.

比賽採用勻稱的電子球。該球會在脈衝模式下發射紅外線光。



Soccer Rules (2013)

P.5

Note: Changes from 2012 rules are highlighted in red.

Translated by RoboCupJunior Hong Kong

4.2 Official suppliers for pulsed balls 脈衝式足球官方供應商

Currently, there is one ball that has been approved by the RoboCupJunior Soccer Technical Committee:
現在 RoboCupJunior 足球技術委員會已認可一種電子球。

- RoboSoccer RCJ-05 ball operated in MODE A (pulsed) made by EK Japan/Elekit (www.elekit.co.jp)
RoboSoccer RCJ-05足球於模式A下操作，並由EK Japan/Elekit製造(www.elekit.co.jp)

Technical details are in the Appendix: "Technical Specification for pulsed Soccer Ball"

技術詳情於附件內：“Technical Specification for pulsed Soccer Ball”。

4.3 Tournament balls 比賽足球

Balls for the tournament must be made available by organizers. Organizers are not responsible for providing balls for practice.

比賽用球必須由大會提供。大會無責任提供練習用球。

5. GAME PLAY 比賽

5.1 Game procedure and length of a game 比賽程序和賽長時間

A game will consist of two halves. The duration of each half is 10-minutes. There will be a 5-minute break in between the halves.

比賽分上下半場，各十分鐘。中場休息5分鐘。

A game clock will run for the duration of the halves without stopping (except if or when the referee wants to consult an official). The game clock will be run by a referee or an assistant (see Rule 7.1 for the description of a referee assistant). 整場比賽將持續計時(兩個10分鐘半場)，中途不間斷(除非當裁判需要諮詢官方人員)。比賽用的計時器由裁判員或其助手負責(見規則7.1，裁判助理的描述)。

Teams are supposed to be at an assigned field table 5 minutes before their game starts. **To be at the inspection table does not count in favor of this time limit.** Teams can be penalized one goal per minute at a referee's discretion if they are late for the game start. If a team does not report within 5 minutes of the game start, it is considered a forfeit of the game and the winning team is awarded a 5-0 win.

隊伍應該於比賽開始的前5分鐘到達所分配的賽場，**隊伍於檢車區(桌)不視作到場，繼續時限倒數。**如隊伍遲於比賽開始時間到達，裁判將可執行判罰：該隊每遲到一分鐘，敵隊可獲得一個入球。如隊伍於比賽開始後5分鐘仍未到場，則該場比賽結束，敵隊以5：0 的分數勝出。

5.2 Pre-match meeting 賽前會議

At the start of the first half of a game, a referee will toss a coin. The team mentioned first in the draw shall call the coin. The winner of the toss can choose either their side of a field, or kick off. After the first half, teams will switch sides. The team not kicking off in the first half of the game will kick off to begin the second half of the game.

上半場開始時，由裁判進行拋擲硬幣，由最先進入本輪的參賽隊伍先猜。猜贏的一方可選擇 (a) 挑邊或 (b) 開球。另一選項由猜輸的一方決定。上半場結束後，隊伍雙方對調比賽場地。上半場無開球權的隊伍將在下半場先開球。

5.3 Kick off 開球

Each half of a game begins with a kick off. All robots must be located on their own side of the field. All robots must be still with no parts moving. A ball is positioned by the referee in the center of a field.

以開球形式開始每個半場比賽。所有的機械人必須位於自己的半場。所有機械人必須停住不動。裁判將球放到場地中央。

The team kicking off places their robots on the field first. Robots cannot be placed nor remain behind the goal line or in the out area. Robots cannot be repositioned once they are placed.

獲得開球權的一方須首先把機械人放到賽場上。機械人不能擺放在球門線後，也不能擺在外場區域。一旦放好，不得移動機械人。



Soccer Rules (2013)

P.6

Note: Changes from 2012 rules are highlighted in red.

Translated by RoboCup Junior Hong Kong

The team not kicking off will now place their robots on the defensive end of the field. All robots on the team not kicking off must be at least 30 cm away from the ball (that means outside the center circle).

不獲開球權的一方將他們的機械人放到自方的場地。不獲開球權一方的所有機械人與足球距離至少30cm(即中央圓圈外)。

The referee may adjust the placement of the robots to make sure that the robots are placed properly within the field positions.

裁判可以調整機械人的擺放位置，以確保機械人被正確地放置在場內的位置。

On the referee's command (usually by whistle), all robots will be started immediately by each captain. Any robots that are started early will be removed by the referee from the field and treated as a damaged robot.

在裁判下令後(一般用哨子)，所有的機械人立刻由每隊之隊長啟動。在裁判哨聲前搶先啟動的機械人將被裁判移離比賽場地，並當作「損壞的機械人」處理。

5.4 Human interference 人為干擾

Except for the kick-off, human interference from the teams (e.g. touching the robots) during the game is not allowed unless explicitly permitted by the referee. Violators can be disqualified from the game.

除開球以外，除非有裁判明確批准，否則比賽期間是不容許有來自隊伍的人為干擾(如解碰機械人)。違規者可被取消比賽資格。

The referee or a referee assistant can help robots to get unstuck, but only if the ball is not being disputed near them, and also if that situation was created from the interaction between robots (i.e. it was not a design or programming flaw of the robot alone). The referee or a referee assistant will pull back the robots just enough for them to be able to move freely again.

裁判或助理裁判可以幫助機械人擺脫纏繞，但只限於在機器人未在足球旁、且由於機器人間的對抗而造成被卡住的情況(例：這並非機械人的計設或程式流程)。裁判或助理裁判將把機械人拉到足夠讓他們可再次自由移動的位置。

5.5 Ball movement 足球運動

A robot cannot hold a ball. Holding a ball means taking full control of the ball by removing all of its degrees of freedom. Examples of ball holding include fixing a ball to a robot's body, surrounding a ball using a robot's body to prevent access by others, and encircling the ball or somehow trapping the ball with any part of a robot's body. If a ball stops rolling while a robot is moving or a ball does not rebound when rolled into a robot, it is a good indication that the ball is trapped.

機械人不得「持球」。「持球」的意思是，通過堵死足球去路從而實現的完全控球。比如說，把球固定在機械人身上；機械人用身體圈住球來阻止其它機械人觸球；或使用機械人身體的任何部分將球包圍或設法圈住。機械人移動時球停止滾動，或是球滾動撞到機械人身體時沒有回彈，這就說明球是被圈住的。

The only exception to holding is the use of a rotating drum that imparts dynamic back spin on a ball to keep the ball on its surface. Such a device is called a dribbler.

持球唯一例外是使用轉盤裝置，它可以給球提供向後旋轉的動力，將球維持在轉盤的表面上，這稱為「盤/運球」。

Other players must be able to access a ball.

其它機械人必須能接觸到球。

5.6 Scoring 計分

A goal is scored when the entire ball is inside the goal or if it strikes the back wall of the goal. Goals scored either by an attacking or defending robot have the same end result: they give one goal to the team on the opposite side. After a goal, game will be restarted with a kick-off from the team who received the goal against.

當整個足球完全越過球門線或是球碰到球門後壁，即為進球。進球得分在進攻或防守一方的機械人上同樣適用：進球至對手球門的隊伍獲一分。進球後，將由失分的一方重新開球，繼續比賽。



5.7 Goalie 守門員

A robot moving first into the penalty area completely (with every part of it) on a team's defending side is designated as goalie until a part of it leaves the penalty area.

防守方隊伍最先完全(機體每個部分)進入罰球區的機械人被界定為「守門員」，直至該機械人的一部分離開罰球區。

5.8 Pushing 推撞

Within a penalty area, a goalie has priority. Attacking robots are not supposed to push the goalie in any way.

於罰球界內，守門員有優先權，進攻的機械人不能以任何方式推撞守門員。

If an attacker and a goalie touch each other and at least one of them has physical contact with a ball, the ball will be moved to the nearest unoccupied neutral spot immediately.

如攻方球員與守門員有接觸及最少其中一方觸碰著足球，足球將立即被放到沒被佔用而最近的發球點。

If a goal is scored as a result of this pushed-situation, it will not be granted.

如推撞情況下進球，將判進球無效。

5.9 Lack of progress 進展中斷

Lack of progress occurs if there is no progress in the gameplay for a reasonable period of time and the situation is not likely to change. Typical lack of progress situations are when the ball is stuck between robots, when there is no change in ball and robot's positions, or when the ball is beyond detection or reach capability of all robots on the field. After a visible and loud count, (usually a count of five, the length of the count could be decided by the OC before a competition as long as it's the same length within a sub-league) a referee will call "lack of progress" and will move the ball to the nearest unoccupied neutral spot. If this does not solve the lack of progress, the referee can move the ball to different neutral spots.

進展中斷發生指比賽於合理的時段內沒有進展和情況沒有改變跡象。典型的進展中斷，當球被多個機械人夾住，或者卡在機械人和牆壁之間，或者沒有機械人能探測到足球位置。裁判將示意「進展中斷」並將足球放到沒被佔用而最近的發球點。如未能解決進展中斷，裁判可將足球放到不同發球點。

5.10 Out of bounds 出界

If a robot's entire body moves out beyond the white line of the field completely, it will be called for being out of bounds. When this situation arises, the robot is given a one-minute penalty, and the team is asked to remove the robot from the field. The robot out time starts once the robot is removed. There is no time stoppage for the game itself.

如果整個機械人走出場地的白線外，這稱為出界。當這情況發生時，隊伍會被要求將該機械人移離賽場一分鐘作處罰。當機械人被移離賽場的期間，比賽的計時是沒有停止的。

After the penalty time has passed, robot will be placed on the unoccupied neutral spot nearest to where it has been taken off, and not directly aiming towards the ball.

處罰時間過後，機械人將被放置於其離場位置附近空置的發球點，但不應直接朝向足球方向。

A referee can waive the penalty if the robot was accidentally pushed out of bounds by any other robot. In such a case, the referee may have to slightly push the robot back onto the field.

裁判可免除處罰，如果該機械人是意外地被其他機械人推出界外。在這樣的情況下，裁判可稍微把機械人推回內場區域。

The ball can leave and bounce back into the playing field. If it remains outside the playing field too long or any of the robots are unable to return it into the playing field (without their whole body leaving the field), after a visible and loud count the referee will call "out of reach" and will move the ball to the nearest unoccupied neutral spot.

足球可離開和反彈回球場內，如足球保持在球場外過長時間或未有機械人能把足球帶返球場內(整個機械人不可離開球場)。裁判配合手勢大聲倒數過後，表示“球出界”並將足球放置到附近空置的發球點。

5.11 Damaged robots 損壞的機械人

If a robot is damaged, it has to be taken off the field and must be fixed before it can play again. A damaged robot must remain off the field for at least one minute.

如果機械人損壞，機械人將從場地上移走及必須於修理後才能繼續參賽。損壞的機械人必須離場至少一分鐘。



Soccer Rules (2013)

P.8

*Note: Changes from 2012 rules are highlighted in red.
Translated by RoboCup Junior Hong Kong*

A robot is damaged especially when: 界定機械人損壞

- it does not respond to a ball, or is not able to move (it lost pieces, power, etc.)

對足球沒有反應或無發移動 (可能是零件脫落, 斷電等)

- it continually moves into the goal or out of the playing field

持續駛向球門或走出球場外

- it turns over on its own accord

自己翻身倒地

Computers and repair equipment are not permitted in the playing area during gameplay. Usually, a team member will need to take the damaged robot to an "approved repair table" near the playing area, located inside the competitors working area. A referee may permit robot sensor calibration, computers and other tools in the playing area, only for the 5 minutes before the start of each half.

球隊期間, 電腦和維修設備不允許放在足球場。通常隊員需將損壞的機械人拿到足球場附近"被認可的維修桌", 位於參賽者的工作區內。只有在每個半場開始前的5分鐘, 裁判才可能允許在足球場上作機械人傳感器調試、擺放電腦及其他工具。

After a robot has been fixed, it will be placed on the unoccupied neutral spot nearest to where it has been taken off, and not directly aiming towards the ball. A robot can only be returned to the field if the damage has been repaired. **If the referee notices that the robot was returned to the field with the same original problem, s/he could ask the robot to be removed, and proceed the game as if the robot had not been returned.**

機械人完成維修後, 將被放置於其離場位置附近空置的發球點, 但不應直接朝向足球方向。機械人完成維修後方可返回比賽場地。如裁判發覺機械人返回場上仍發生相同問題, 裁判可要求該機械人離場, 並繼續進行球賽, 而該機械人則不能重返場上。

Only a referee decides whether a robot is damaged. A robot can only be taken off or returned with the referee's permission.

只有裁判能夠界定機械人是否損壞, 並且只有在裁判許可下, 可以移走或放回機械人。

If both robots from the same team are deemed damaged during gameplay, the clock continues and the remaining team gets one initial goal and rests while waiting for the opponent's return to play. The remaining team will also get one additional goal for each minute the opponent's robots remain damaged. After five minutes of absence, the team with no functional robots forfeits the game. However, these rules only apply when none of the two robots from the same team were damaged as the result of the opponent team violating the rules.

球賽期間, 如果同一隊伍的兩個機械人都被視為損壞的機械人, 比賽時間繼續, 剩下那支參賽隊獲得一球, 並在等待對手返回賽場的過程中保持休息狀態。如果對方兩個機械人始終無法返回賽場, 剩下的隊伍一分鐘獲得一個球。如果五分鐘後都無法返回, 表示該隊放棄了這場比賽。但是, 由於一方違規而造成另一方機械人損壞的, 不適用本規則。

5.12 Multiple defense 多人防守

Multiple defense occurs if more than one robot from the defending team enters its penalty area with some part, and substantially affects the game. The robot farther from a ball will be moved to the center neutral spot.

多人防守發生, 如防守的隊伍有多於一個機械人進入它們的罰球區及明顯影響球賽。距離足球較遠的防守方機械人將被移至中央發球點。

If multiple defense happens repeatedly, one of the robots will be deemed damaged.

如多人防守重複發生, 該機械人將被視為損壞。

5.13 Interruption of Game 比賽中斷

In principle, a game will not be stopped.

原則上比賽不會停止。

A referee can stop a game if there is a situation on or around a field, which the referee wants to discuss with an official of the tournament or if a ball malfunctions and a replacement is not readily available.

若裁判要求向比賽委員商討情況或場地四周, 或足球失靈及替換的足球尚未準備好, 裁判有權停止比賽。



Soccer Rules (2013)

P.9

Note: Changes from 2012 rules are highlighted in red.
Translated by RoboCupJunior Hong Kong

When a referee has stopped a game, all robots must be stopped and remain on the field untouched. The referee may decide whether the game will be continued/resumed from the situation in which the game was stopped or by a kick off. 當裁判停止比賽，所有機械人需關掉及保持於賽場上不動。裁判可能按比賽停止時的情況繼續賽事或重新開球。

6. CODE OF CONDUCT 操行

6.1 Fair Play 公平比賽

It is expected that the aim of all teams is to play a fair and clean game of robot soccer. It is expected that all robots will be built with consideration to other participants.

期望所有參賽隊伍的目標是公平和“幹淨”地進行機械人足球比賽。期望所有搭建的機械人都顧及其他參加者。

Robots are not allowed to cause deliberate interference with or damage to other robots during a normal game play.

於正常比賽下，不容許機械人故意干擾或損壞其他機械人。

Robots are not allowed to cause damage to a field or a ball during a normal game play.

於正常比賽下，不容許機械人對比賽場地或足球造成損壞。

Humans are not allowed to cause deliberate interference with robots or damage to the field or a ball.

不容許人故意地干擾其他機械人或是故意損壞場地或足球。

6.2 Behavior 行爲

All participants are expected to behave themselves. All movement and behavior is to be of a subdued nature within a tournament venue.

期望所有參加者都能注意自己的言行。所有的活動及行爲必須依照賽場的指示。

6.3 Help 幫助

Mentors (teachers, parents, chaperones and other adult team-members including translators) are not allowed in the student work area without the organizer's permission. Only participating students are allowed to be inside the work area.

除非得到明確批准，教練(教師、父母、監護人和其他的成人隊員，包括翻譯員)不允許駐足於學生工作區域。僅參賽學生可在工作區域內。

Mentors must not touch, build, repair or program any robots.

教練不得觸碰、搭建、維修或編程機械人

6.4 Sharing 分享

The understanding that any technological and curricular developments should be shared among the RoboCup and RoboCupJunior participants after the tournament has been a part of world RoboCup competitions.

這項賽事一直為世界RoboCup比賽的一部分，大家已達成共識，RoboCup和RoboCupJunior的參加者於比賽後應分享任何技術和課程的發展。

6.5 Spirit 精神

It is expected that all participants, students, mentors and parents alike, will respect the RoboCupJunior mission.

期望所有的參與者、學生、教練和父母能尊重 RoboCup Junior 的宗旨。

It is not whether you win or lose, but how much you learn that counts!

比賽意義不在輸贏，重在學習！

6.6 Violations / Disqualification 違規 / 取消資格

Teams who violate the code of conduct can be disqualified from the tournament. It is also possible to disqualify and exclude from further participation in the tournament only a single person or a single robot.

隊伍如有操行違規可被取消參賽資格，這可能是單一人士或單一機械人被取消繼續參賽的資格。



Soccer Rules (2013)

P.10

*Note: Changes from 2012 rules are highlighted in red.
Translated by RoboCupJunior Hong Kong*

In less severe cases of violations of the code of conduct, a team will be given a warning by showing it a yellow card. In severe or repeated cases of violations of the code of conduct a team can be disqualified immediately without a warning by showing it the red card.

對較輕的違規情況，隊伍將獲黃牌警告。對嚴重或重複的違規操作，裁判將向隊伍出示紅牌，無須警告立即取消該隊伍資格。

7. CONFLICT RESOLUTION 衝突解決

7.1 Referee and referee assistant 裁判及助理裁判

All decisions during the game are made by the referee or the referee assistant, who are in charge of a table/field, and people and objects surrounding it. During game play, the referees' decisions are final. During gameplay, the decisions made by the referee and /or the referee assistant are final.

比賽期間裁判及助理裁判有權處理場區內的表格、比賽場地、人和物，並作出所有決定。在比賽期間，裁判享有最終裁定權。球賽期間，裁判和/或助理裁判擁有最終決定權。

Any argument with a referee or an assistant can result in a warning. If the argument continues or another argument occurs, this may result in immediate disqualification from the game.

對裁判決定如有爭論將給予警告；若爭論仍不停止或另一爭論發生，則立即取消其比賽資格。

At the conclusion of a game, the referee will ask the captains to sign a score sheet. By signing the score sheet the captains accept the final score on behalf of entire team.

比賽終結時，裁判將要求隊長於分紙上簽名。於分紙上簽名指隊長代表整個隊伍接受該最終得分。

7.2 Rule clarification 規則解釋

Rule clarification may be made by members of the RoboCupJunior Soccer Technical Committee, if necessary even during a tournament.

比賽期間如有需要，RoboCupJunior足球國際技術委員享有規則解釋權。

7.3 Rule modification 規則修改

If special circumstances, such as unforeseen problems or capabilities of a robot occur, rules may be modified by the RoboCupJunior Soccer Organizing Committee Chair in conjunction with available Technical Committee and Organizing Committee members, if necessary even during a tournament.

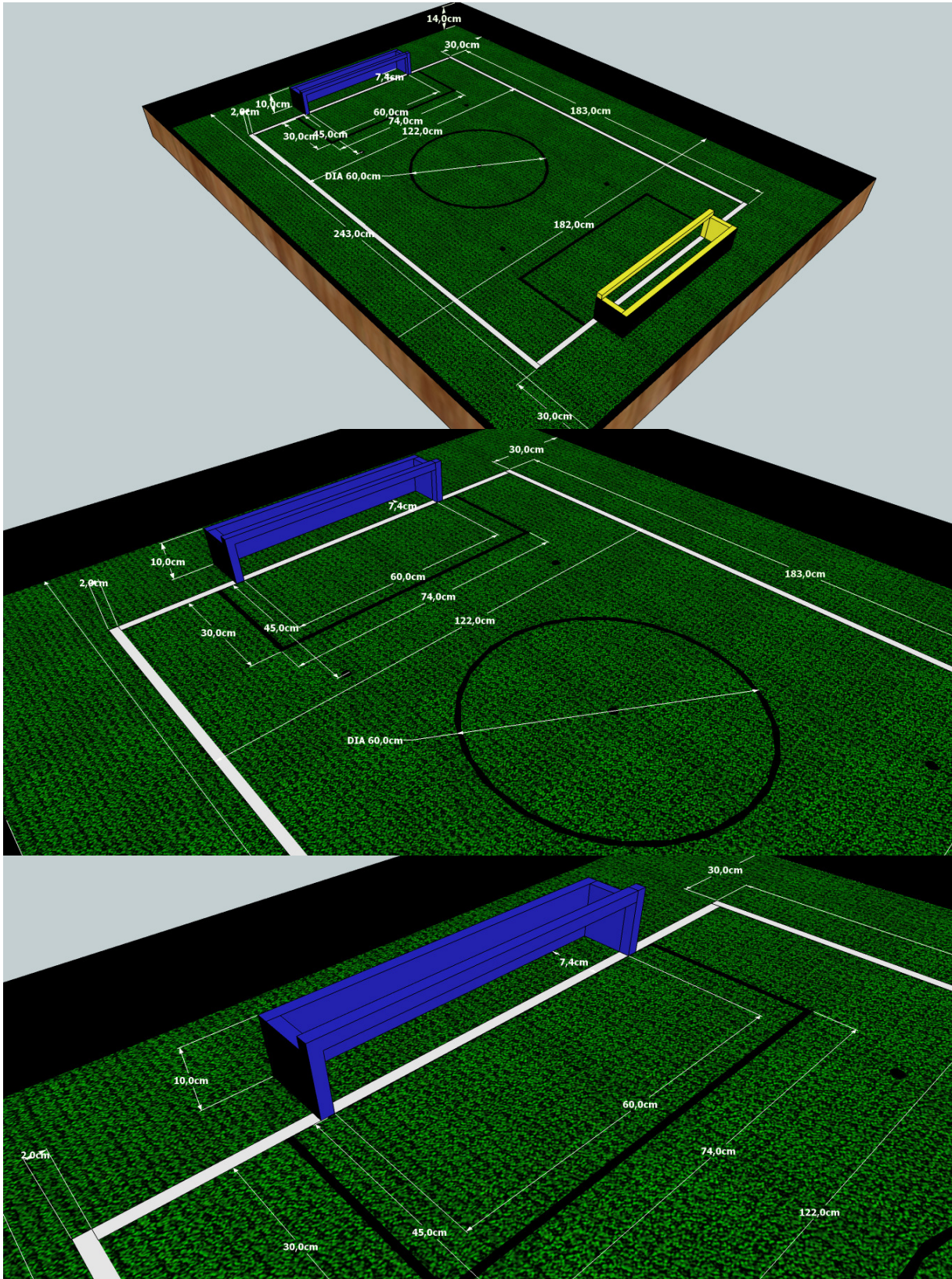
如特殊情況，例如一些無法預料的問題或機械人存在性能的問題。比賽期間如有需要，RoboCupJunior足球組織委員會主席會聯同技術委員會和組織委員會成員一同修改賽規。

7.4 Regulatory statutes 法規章程

Each RoboCupJunior competition may have its own regulatory statutes to define the procedure of the tournament (for example the SuperTeam system, game modes, the inspection of robots, interviews, schedules, etc.). Regulatory statutes become a part of this rule.

每個RoboCupJunior賽事都可有自己的法規章程去定立比賽程序(例如SuperTeam制度、比賽模式、機械人檢測、面試、時間表等)。法規章程成了規則一部份。

Field diagram 場地簡圖





League Regulations 2013

1. Preamble 前言

According to rule 2.7 of the RoboCupJunior Soccer Rules, each league has its own additional regulations. They become a part of the rules.

根據RoboCupJunior Soccer Rules的規則2.7，每個聯盟有自己附加的規則，並可成爲規則的一部分。

Soccer will consist of two sub-leagues. These sub-leagues are called “**Open League**” and “**Light Weight League**” (See 2.1 Dimensions). Each sub-league can be further divided into primary and secondary.

足球將包含兩個子聯盟，稱爲“**公開級**”及“**輕量級**”(見2.1 尺寸)。每個子聯盟可分爲初級組和高級組。

For RoboCupJunior 2013, there are three sub-leagues as follows:

RoboCupJunior 2013有三個子聯盟如下:

- Light Weight League – Primary (初級組)
- Light Weight League – Secondary (高級組)
- Open League (隊員年齡爲19歲以下)

2. Regulations 規則

2.1 Dimensions 尺寸

Robots will be measured in an upright position with all parts extended. A robot's dimensions must not exceed the following limits:

測量時機械人必須處於直立狀態，並且伸展開所有的部件。機械人尺寸不得超出以下限制：

sub-league 子聯盟	Open League 公開級	Light Weight League 輕量級
size / diameter (尺寸)	Ø 22.0 cm	Ø 22.0 cm
height (高度)	22.0 cm *	22.0 cm *
weight (重量)	2400 g **	1100 g **
ball-capturing zone (控球區)	3.0 cm	3.0 cm
Voltage (電壓)	15.0V	12.0V

* The handle of a robot may exceed the height.

機械人的手把可超出該高度。

** The weight of the robot includes that of the handle.

機械人的重量是包括其手把在內。

Ball-capturing zone is defined as any internal space created when a straight edge is placed on the protruding points of a robot. This means the ball must not enter the concave hull of a robot by more than 3 cm. Furthermore, it must be possible for another robot to take possession of the ball.

控球區定義爲：任何突出的部位連接在機械人身上而形成的內部空間。球不得進入機械人外殼深度超過3cm。此外，控球區必須能夠讓另一機械人奪走足球。



Soccer Rules (2013)

P.13

*Note: Changes from 2012 rules are highlighted in red.
Translated by RoboCup Junior Hong Kong*

2.2 Limitations

Voltage pump circuits are permitted only for a kicker solenoid drive. All other electrical circuits inside the robot cannot exceed 15.0 V for Open League and 12.0 V for Light Weight League. Each robot must be designed to allow verifying the voltage of power packs and its circuits, unless the nominal voltage is obvious by looking at the robot, its power packs and connections.

升壓電路僅可供踢球器的螺線管使用。機械人的其他所有電子電路，於公開級不得超過15.0V，輕量級不得超過12.0V。每台機器人的每個電源都必須有一個接口，以便測量電壓，除非該機械人的電源從外觀和連接方式就能明顯看出它的電壓。

Pneumatic devices are allowed to use natural air only.

充氣裝置僅允許使用自然氣體。

Kicker strength is subject to compliance check at any time during the competition. During gameplay, a referee can ask to see a sample kick on the field before each half, when a damaged robot is returned to the field, or when the game is about to be restarted after a goal. If the referee strongly suspects that a kicker exceeds the power limit, he can require an official measurement with the 'Kicker Power Measure Device'. (See the Appendix 'Kicker Power Measure Device' for details.)

比賽期間任何時候，都可能檢測踢球器的力量。球賽期間於以下情況，在每個半場前，當損壞的機械人重返賽場，或當進球後重新開球，裁判可要求觀看機械人示範踢球。如裁判強烈懷疑踢球器超出功率限制，可要求採用官方的'踢球器功率測量裝置'進行量度。(詳情見附件 '踢球器功率測量裝置')

2.3 Construction 搭建

Robots must be constructed exclusively by student members of a team. Mentors, teachers, parents or companies may not be involved in the design, construction, and assembly of robots.

機械人必須僅由隊伍的學生搭建。導師、老師、家長或公司不能參與機械人的設計、搭建及組裝。

For the construction of the robots any robot kit or building block may be used as long as the design and construction are primarily and substantially the original work of the team. This means that commercial kits may be used but must be substantially modified by the team. It is neither allowed to mainly follow a construction manual, nor to just change unimportant parts.

搭建機械人的任何機械人套件或積木均可被使用，只要設計和搭建主要及明顯的為隊伍所原創。意思是可使用商業套件，但必須經過隊伍的明顯修改。不容許大致跟隨搭建說明書搭建，亦不容許修改不重要的部份。

Indications for the violation are the use of commercial kits that can be assembled in only one way or robots are taken from other team(s), build from the same commercial kit, all basically look or function the same.

使用商業套件會被視作違規，如基本上只集中於一處或實際上機械人是來先別的隊伍，搭建的機械人與商業套件基本上是一樣。

Robots must be constructed in a way that they can be started by the captain without the help of another person.

搭建的機械人必須可被隊長啟動且無須另一人幫助。

Since a contact with an opponent robot and/or dribbler that might damage some parts of robots cannot be fully anticipated, robots must have all its active elements properly protected with resistant materials. For example, electrical circuits and pneumatic devices, such as pipelines and bottles, must be protected from all human contact and direct contact with other robots. When batteries are transported or moved, it is recommended that safety bags be used. Reasonable efforts should be made to make sure that in all circumstances robots avoid short-circuits and chemical or air leaks.

由於與對手的機械人和/或盤球器接觸，可能會損壞機械人的一些部分是無法完全可預計的，所以機械人的所有活動元件必須採用有抵抗力的材質正確地保護著。例如，電路和氣動裝置，像電線管道和氣瓶，必須獲得保護，避免與人和其他機械人直接接觸。當搬運和移動電池組，建議使用安全包。應作出合理努力確保在任何情況下，機械人避免短路和化學品或空氣洩漏。



Soccer Rules (2013)

P.14

Note: Changes from 2012 rules are highlighted in red.

Translated by RoboCup Junior Hong Kong

2.4 Programming 編程

Robots must be programmed exclusively by student members of a team. Mentors, teachers, parents or companies must not be involved in the programming and debugging of robots.

機械人必須僅由隊伍的學生編寫程式。導師、老師、家長或公司不能參與機械人的編程及調試。

For the programming of the robots any programming language, interface or integrated development environment (IDE) may be used. The use of programs that come together with a commercial kit (especially sample programs or presets) or substantial parts of such programs are not allowed. It is not allowed to use sample programs, not even if they are modified.

爲了編寫機械人程式可使用任何程式語言、介面或智能開發環境(IDE)。使用的程式是來自商業套件(尤其是程式範例或預設)或程式重要的部分都是不容許。這不允許使用範例程式，即使對其作出修改。

2.5 Inspection and Interviews 檢錄和面試

Robot must be inspected and certified every day before the first game is played. The Organizing Committee may request other inspections if necessary. The routine inspections include:

每天第一場比賽前機械人都必須進行檢驗和鑒定。組織委員會可能還會根據需要進行其他的檢查。檢驗流程包括：

- Weight restrictions for the particular sub-league (see 2.1).
對特定子聯盟的重量限制(見 2.1)
- Robot dimensions (see 2.1).
機械人尺寸(見 2.1)
- Voltage restrictions (see 2.1 and 2.2).
電壓限制(見 2.1 及 2.2)
- Kicker strength limits, if the robot has a kicker. (See the Appendix 'Kicker Power Check Device'.)
踢球器力量限制，如機械人裝有踢球器 (見附件'踢球器功率測量裝置')

Proof must be supplied by each team that their robots match these regulations, for example by a detailed documentation or log book. Teams may be interviewed about their robots and the development process at any time during a tournament.

每隊必須提供證據，他們的機械人符合這些規則。例如：詳細的文件或記錄冊。比賽的任何時候，隊伍可能被面試有關他們的機械人及研發過程的事宜。

The Organizing Committee will arrange to interview teams during the first few days of the event (see 2.3, 2.4, and 2.6). Teams must bring both robots and their computer code to the interview.

組織委員會將於賽事的首幾天安排隊伍面試(見2.3, 2.4和2.6)。隊伍必須帶備機械人及電腦程式一同前往面試。

During an interview, at least one member from each team must be able to explain particularities about the team's robots, especially with regards to its construction and its programming. An interviewer may ask the team for a demonstration. The interviewer may also ask the team to write a simple program during the interview to verify that the team is able to program its robot.

面試期間，每隊中最少一名隊伍可解釋其隊伍的機械人特性。特別是涉及機械人的結構和程式。面試官可能要求隊伍示範。面試官亦可能要求隊伍在面試中編寫簡單的程式以證明隊伍有能力爲機械人編程。

2.6 Violations 違規

Robots that do not match the above regulations are not allowed to play. If violations are detected during a running game, the team is disqualified for that game. If similar violations occur repeatedly, the team can be disqualified from the tournament.

機械人未能符合上述規則，是不會被批准比賽。如球賽進行期間發現違規，該場球賽中隊伍會被取消資格。如類似違規再次發生，隊伍可被取消所有參賽資格。



Technical Specification for pulsed Soccer Ball

1. Preamble 前言

Answering to the request for a soccer ball for RCJ tournaments (more robust to interfering lights, less energy consuming, and mechanically more resistant), the RCJ Soccer Technical Committee defined the following technical specifications with the special collaboration from EK Japan and HiTechnic.

回應成爲RCJ比賽用足球的要求，需要較能抗干擾光線、較低電源消耗及物理上較耐用。RCJ足球技術委員會特別與EK Japan及HiTechnic合作，定義了以下技術規格。

Producers of these balls must apply for a certification process upon which they can exhibit the RCJ-compliant label and their balls used in RCJ tournaments.

足球的生產者必須申請認證過程以示他們可以展示RCJ兼容的標籤和他們的足球可在RCJ比賽中使用。

Balls with these specifications can be detected using specific sensors from HiTechnic (IRSeeker - information on distance and angle) but also common IR remote control receivers (TSOP1140, TSOP1240, GP1UX511QS, ... - on-off detection with a possible gross indication of distance).

足球具備這些規格，可使用由HiTechnic(IRSeeker – 距離及角度的資料)指定的感應器來探測，還有常見的紅外線遙控接收器(TSOP1140, TSOP1240, GP1UX511QS, ...-通斷檢測兼具可能的總距離讀數)。

2. Specifications 規格

2.1 IR light 紅外線

The ball emits infra-red (IR) light with wavelengths in the range 920nm - 960nm, and pulsed at a square-wave carrier frequency of 40kHz. The ball should have enough ultra bright and wide angle LEDs to minimize unevenness of the IR output.

足球發射紅外線光波長範圍由920nm-960nm，脈衝於方波載波頻率爲40kHz。足球必須有足夠特亮及廣角度的LEDs以將參差不齊的紅外線輸出減到最少。

2.2 Diameter 直徑

The diameter of the ball shall be in the range 74mm. A well-balanced ball shall be used.

足球直徑範圍由74mm。使用的是勻稱的球。

2.3 Drop Test 掉落測試

The ball must be able to resist normal game play. As an indication of its durability, it should be able to survive/undamaged a free-fall from 1.5 meters onto a hardwood table or floor.

足球必須能夠承受一般球賽。作爲界定足球的耐久性，足球於1.5米處自由掉落於硬木枱或地板上也應能完整無缺和無損壞。

2.4 Modulation 調整

The 40kHz carrier output of the ball shall be modulated with a trapezoidal (stepped) waveform of frequency 1.2kHz. Each 833-microsecond cycle of the modulation waveform shall comprise 8 carrier pulses at full intensity, followed (in turn) by 4 carrier pulses at 1/4 of full intensity, four pulses at 1/16 of full intensity and four pulses at 1/64 of full intensity, followed by a space (i.e. zero intensity) of about 346 microseconds. The peak current level in the LEDs shall be within the range of 45-55mA. The radiant intensity shall be more than 20mW/sr per LED.

足球的40kHz載波輸出將被調整，梯形波形頻率爲1.2kHz。調整波形以每833微秒循環的週期組成8個最大強度的載波脈衝，接著(反過來)的是4個載波脈衝(爲最大強度的1/4)，4個脈衝(爲最大強度的1/16)及4個脈衝(爲最大強度的1/64)，接著約346微秒是空白(即強度爲0)。LEDs的峰值電流水平需在45-55 mA的範圍內。每枝LED的光線強度需大於20mW/sr。



Soccer Rules (2013)

P.16

Note: Changes from 2012 rules are highlighted in red.

Translated by RoboCupJunior Hong Kong

2.5 Battery Life 電池壽命

If the ball has an embedded rechargeable battery, when new and fully charged it should last for more than 3 hours of continuous use before the brightness of the LEDs drops to 90% of the initial value. If the ball uses replaceable batteries, a set of new high-quality alkaline batteries should last for more than 8 hours of continuous use before the brightness of the LEDs drops to 90% of the initial value.

如足球使用的是充電電池，當剛剛完整充電後，足球在持續使用多於3個小時前，其LED亮度只跌至初始值的90%。如足球使用的是一般電池，以一套全新且高質數的鹼性電池而言，足球在持續使用多於8個小時前，其LED亮度只跌至初始值的90%。

2.6 Coloration 染色

The ball shall be neutral in color. In particular, it must not have any green, blue or yellow coloration (to avoid confusion with the colors of the field and goals).

足球應是中性的顏色。特別是足球不可有任何綠色、藍色或黃色染色(避免與場地及球門的顏色混淆)。

Note: The English version of these rules shall prevail wherever there is a discrepancy between the English and the Chinese versions.

注意：本賽規的中英文本如有歧義，概以英文本為準。

Kicker Power Measuring Device 踢球器功率測量裝置

1. Preamble 前言

This Kicker Power Measuring Device can measure the power of a robot's kicker. It is easy to build with commonly accessible materials.

踢球器功率測量裝置可量度機械人踢球器的力量。它的搭建容易且所常見的易找的材料。

This device can measure the power of a robot's kicker up to a length of 22cm.

此設備可量度機械人踢球器功率踢起至長度22厘米



2. Materials 材料

Plastic Board (膠板)	A4 paper size (A4紙大小)
M3 Spacers (M3支柱)	5
M3 Screw (M3螺絲)	10

3. Device schematics 裝置圖側

The device schematics can be printed out from the diagram located at the end of the document. Please be advised to check that the software you use to print the schematic does not have a "scale to fit" option activated (i.e. check that it is configured to print at 100% or "actual size" scale).

裝置圖側可被打印並位於文件的尾末。請注意檢查您使用的軟件，打印選項中"縮放切合"沒有被選擇(如檢查所打印的圖側為100%或實際尺寸比例)。

Note: The device schematics shows a straight line past the 22cm mark, while the photo shows the line at that point to be curved. Either straight or curved lines are acceptable, but a curved line will request more difficult cutting and the attached device schematic is simple enough for quick construction.

注意：裝置圖側顯示著直線上的22厘米記號，儘管圖片所示直線22厘米該點伸延出曲線。不論直線或曲線都接受，但曲線的切割較困難和附件的裝置圖側相當簡單且可快速施工。



Soccer Rules (2013)

P.18

Note: Changes from 2012 rules are highlighted in red.
Translated by RoboCupJunior Hong Kong

4. Example of device construction 裝置結構樣本

- a. Print out the device schematics.
打印裝置的圖側。
- b. Paste the paper on a plastic board. The incline line (red lines) should be straight.
圖側紙樣貼到塑板上，斜線(紅線)應筆直。
- c. Cut out along the lines, and drill the holes.
沿線切割和鑽孔。
- d. The two boards should be connected using the 40mm spacers.
兩片塑板應由40mm的支柱連接。

5. Inspection 檢查

- a. Place a ball at the bottom of the ramp run of the device, and put the robot in front of the ball, aiming the kicker towards the top of the ramp.
將足球放在裝置的斜坡底部，機械人放在球的前方，踢球器瞄準斜坡的頂部。
- b. Activate the robot's kicker for a single shot.
觸發機械人的踢球器射球。
- c. Measure the distance that the ball travelled on the device.
測量球在裝置上的移動距離

Kicker Power Measuring Device

RoboCupJunior Soccer Technical Committee

NOTE: You might need to set up to the magnification ratio "100%" of this print.

$$37 \cdot \sqrt{969} \cos 20^\circ \approx 0.77 \text{ cm}$$

