

The Rules of Collegiate Robotic Football AKA Mechatronic Football

This document sets forth rules of the game of Collegiate Robotic Football. These rules are subject to change in accordance with the evolution of the competition. Except as noted below, the competition follows all NCAA rules, including coin tosses, referee guidelines, unsportsmanlike conduct (by either machine or human), late hits, and so on. Referees shall treat the Players as humans for the purpose of application of the NCAA rules of collegiate football.

A. Players and Teams

1. The game is played by two opposing teams, each consisting of remotely controlled robots, referred to as Players.
2. No more than 8 Players from a Team are allowed on the playing field during a play, i.e. the game is 8-on-8. A delay of game penalty is assessed for having an excess of Players on the field at the beginning of a play, resulting in a 5' penalty marked from the line of scrimmage.
3. Humans are not allowed to intentionally touch any of the Players on the field of play with the following exceptions. One individual from the offensive team is allowed to:
 - a. Place the ball over the body of the center or on the floor in front of the center before an offensive play.
 - b. Place the ball on the kicking tee before a kicking play and prepare the Player to kick.

This person must make a sincere effort to be off the field before the play starts. Once intentionally touched by a human, a Player is considered injured/damaged and cannot participate in the next play unless the team calls a time out. If the play starts with such a player on the field, a 5' delay of game penalty results.

4. Locomotion of Players must be DC powered, with a 24v maximum circuit voltage. Other stored energy sources can be used to power Player accessories as long as they are safely engineered. Any lead acid batteries must be sealed.
5. Human and Robot Safety:
 - a. Players must have a kill-switch mounted externally on their top surface, easily reached. When activated, the switch should disconnect the main power to the system. Additional details are provided in the Technical Appendix.
 - b. Every Team must have their own fire extinguisher at every CRFC event.
 - c. A Team will receive a first-time warning for a runaway robot due to loss of control. In the event that the same Player has a second control failure,

that Player is ejected from the game.

6. All Players will be positioned on the field by remote control. Teams may not interfere with the signals broadcast from the opposing Team.
7. A specified digital accelerometer (tackle sensor) is required to sense if an upsetting event (knockdown, fall down, or tackle) has occurred. The code determining if an upsetting event has occurred, based on the accelerometer's output, will be provided. The tackle sensor must be rigidly mounted in a horizontal orientation to a horizontal interior surface of each Player's base plate in a manner that enables a trainer to manually activate the reset button on the tackle sensor within 10 seconds and a cable to be attached to reload the tackle sensor software within 1 minute. The tackle sensor must also be mounted so that when the unit faces directly downfield, the tackle sensor is square to the end zone.
 - a. Only the quarterback, wide receivers, and running backs will be required to have tackle sensors. Other units do not require tackle sensors, but any unit that carries the ball will be required to have a tackle sensor regardless of that unit's functional designation. Any violation of this rule results in an "ineligible player" violation and a 5' penalty.
 - b. Only Players with tackle sensors may advance the ball.
8. At least one single multi-color, high-intensity LED light, viewable from all directions, is to be used to indicate Player status. During normal play, each Player on the field will display a designated color for identification and status.
 - a. A player in "go" status shall have a GREEN light visible from all directions.
 - b. A Player in possession of the ball is tackled when an upset-event has been detected by the tackle sensor and activates the RED light, which shall remain lit for 2-seconds minimum.
 - c. Offensive Linemen must be clearly distinguished by a BLUE light visible from all directions so referees can determine eligibility. Offensive Linemen must be within 6 feet on either side of the ball and on the line of scrimmage at the snap.
9. At their discretion, the referees may verify that any Player has a functioning tackle sensor at any dead ball. If a ball carrier goes out of bounds or into the end zone and the referees determine immediately afterward that the tackle sensor is

not functioning properly, a 15' penalty and loss of down will be assessed and the Player will be removed from play until it is repaired. For non-ball carriers, the penalty will be just the 15' penalty without loss of down.

10. A Player's base plate must be solid and made of HDPE not thinner than ½ inch. A reasonable number of clearance holes for component mounts, component clearance, fasteners, wheels, and wires are allowed. The outside of the base plate must be completely ringed with a bumper (specifications in the Technical Appendix) that can be directly contacted from any horizontal direction by another Player's bumper-covered base plate. This requires that no fixed/permanent part of a Player may protrude beyond a vertical prism projected up and down from the base plate's bumper.
11. Stiff-arming is not allowed. Violation of this rule results in stoppage of play, loss of down and 15'. Stiff-arming is defined as the extension of any material beyond the perimeter of the base plate that impedes the ability of an opponent to contact a Player's base plate and thus block or tackle a Player. If an appendage is deployed by a Player who is carrying the ball, upon simple contact by an opponent with the deployed appendage, the referee will call a touch-tackle and the play will be dead and the penalty enforced.
12. Players do not have to wear "jerseys," but must be readily identifiable from the sidelines as a member of their Team through the use of colors, school-unique stickers on each side of the Player, and large, visible numbers.
13. A touchdown occurs once the entire body of the robot crosses the leading edge of the goal line. This rule obviates the need for referees to see where the ball is located as it breaks the plane of the end zone.
14. The Kicker will perform a kick by striking the ball with a solid object. Stored mechanical energy may be used to power the device that kicks the ball. Punting and place-kicking (kickoff, field goal and point-after touchdown) are nominally identical. The kicking tee, upon which the ball can be manually placed, can elevate the lowest portion of the ball no more than 3 inches above the playing surface. The kicking tee may be an integral part of the Kicker or may be physically separate.
15. When a Team elects to either punt or kick a field goal, it must verbally notify the referee and opponent which action it is taking prior to the placement of the ball on the Kicker/tee.
16. Pre-Game Measurements
 - a. Tackle Sensor Kick Test - Officials will "kick test" each robot with a tackle

sensor to ensure its tackle sensor is functionally wired. A robot cannot take the field if its LED light does not illuminate during the kick test. The conference will have a supply of tackle sensors available for any failure, but it is the responsibility of the team to install a new tackle sensor.

- b. Base Plate Height - The centerline of a Player's base plate measurement tolerance must be located $2-13/16 - 3-3/16$ (3" plus or minus 0.2") inches above the playing surface when the unit is at rest. This distance can also be measured at any point during play by a referee, and if the Player is out of tolerance, the Player is no longer eligible to play.
- c. Light Inspection - Each robot with a tackle sensor shall be tested that its LED light is clearly visible from all angles and sides. A robot that fails this test will not be allowed to compete.
- d. Quarterbacks and Kickers can weigh no more than 45 pounds, and all other Robots can weigh no more than 30 pounds.
- e. There are no restrictions on the shape of a base plate or Player, but all Players, except the Center and the Kicker, must fit within a 16 inch square, 24 inch tall box at the beginning of any play (bumpers included from 2019 on). Only the Center may reach out from beyond this footprint before a play to deliver the ball to another Player. The Kicker may be rectangular and must fit within a 16 inch by 24 inch rectangle, and not be more than 24 inches tall.
- f. Tires must be mounted on rigid, solid, wheels. Plastic is an acceptable material. Foam tires are allowed, but they can be no thicker than 1/2 inch and no softer than 20 Shore. Pneumatic tires are not allowed. Suspensions and shock absorbing systems are not permitted.
- g. Players, other than the center to which this rule does not apply, can have no more than 2 extensible arms consisting only of rotational joints.

B. Player and Ball Positioning

1. A kicked Point After Touchdown (PAT) is spotted at the 10' mark. The Defense cannot rush the kicker and the offense is not required to line up during the attempt.
2. At the beginning of each half, after a touchdown, and after a field goal, the defending team kicks off to the receiving team from the one-third field mark of their own territory. The kicking team may place the ball anywhere between the hash marks for their kickoff. The clock is started, and play is initiated when the

Kicker contacts the ball. Since the receiving team is effectively the offense, three humans may be in or behind the receiving end zone as specified in rule B.14.

3. On kickoff, the receiving team must line up behind the midfield line or marker. If the ball does not pass the midfield line or marker on the kick-off, only the receiving team may take possession of the kicked ball. During kick-off, if the ball passes the midfield line or marker, it will be considered live and may be recovered by either team.
4. Any kick is caught by the first Player touching the kicked ball. If that Player can take possession of the ball before advancing it more than 10', before being tackled by an opponent, and before a second player touches the ball, the Player may advance the ball if it has a tackle sensor.
5. If the kicking team has an inoperable kicker, a QB may substitute and throw the ball to the opposing team. However, the throw must be made from the PAT line and cannot result in the kicking team recovering the ball. The throw must result in a change of possession.
6. On kickoff, if a ball is kicked out of bounds, the receiving team has the option to: (1) take possession of the ball from the point on the field where the out of bounds occurred, or (2) take possession of the ball at the midfield line. If a ball is kicked into or past the End Zone, the Receiving Team takes possession of the ball at the one-third field mark of their territory.
7. The referee initiates any kind of kicking play by blowing a whistle following an indication from the kicking team's coach that the Kicker is ready. To simulate the time it takes for a human to run up and kick the ball, the Kicker cannot kick the ball earlier than 2 seconds after the initiation of the play. The penalty is a replay of the down and a loss of 15'.
8. On a punt, the Defense cannot rush the kicker. The Team receiving a punt will take possession at the point where one of its Players touches the ball. If that Player can take possession of the ball in accordance with the same standards as Rule B.4, the ball may be advanced. If the ball goes out of bounds, it is spotted at the point it goes out of bounds.
9. If the ball crosses the plane of the Goal Line into the End Zone at any point and then comes to rest prior to coming into contact with any Player, or if the ball is punted out of the back of the End Zone, the Receiving Team takes possession of the ball at the one-third field mark of their territory. However, the Receiving Team does have the option of taking possession of the ball in the End Zone and advancing the ball in accordance with the same standards as Rule B.4.

10. A first down is realized when a one-third span of the field is covered within 4 plays (See the Event Layouts document for first down lines).
11. Because its wheels are not easily viewed by the referees, a Player is considered out of bounds when any portion of its footprint crosses the inside of a sideline or endline.
12. Each Team will have a sideline area on one-half of the field (See the Event Layouts document for playing field orientation). The direction of play will remain the same for the entire game, with a team's sideline area being on their offensive side of the line of scrimmage. Humans controlling the Players and engineers providing service to Players are restricted to this area except as noted in Rules B.13 and B.14.
13. Offensive Player controllers can enter the playing field between plays to facilitate positioning their Players on the line of scrimmage prior to the snap of the ball. A referee will stand on the hash mark, 10' from the line of scrimmage on the offensive side of the line of scrimmage creating a Safety Boundary. The offensive team human controllers who are on the field cannot move any closer to the line of scrimmage as written in Rule F.7a. Doing so is an offsides penalty, assessed by a 5' penalty marked from the line of scrimmage.
14. Once the offensive Players are positioned, all but three of the offensive Player controllers must return to their sideline prior to the snap of the ball. Three offensive Player controllers may remain on the field during the play but must remain behind the Safety Boundary for the entire play. If the Player with the ball or the ball itself approaches their location, they must make an obvious effort to retreat or leave the playing surface.
15. Defensive Player controllers are restricted to their designated sideline areas at all times.
16. After each play, the referee spots the forward progress of the ball with a "toe-spot", marking the new line of scrimmage. If yardage was gained in the previous play, the ball will be toe-spotted at the point of maximum forward progress of the ball. If yardage was lost, the ball will be toe-spotted at the point where the ball was located when the Player was tackled. If the play ends outside of the hash marks, the ball will be spotted on the hash marks closest to the side of the field where the play ended. If the play clock has been stopped, it will restart when the referee has spotted the ball on the field. The Human controller of the Center may reorient the ball on the floor with no penalty as long as the ball does not change position on the field.

17. The Center will line up with its leading edge on the line of scrimmage indicated by the referee's spot but may extend a reasonable amount over the ball if the handoff is to occur without human intervention.
18. Loss of the football by a robot shall presumptively be called a fumble unless the fumble is the result of an illegal hit. The team that first touches a fumbled ball gains possession. If the Player who touches the fumbled ball can take possession of it in accordance with the same standards in Rule B.4, that Player may advance the ball.

C. Game Timing

1. Pre-Game Activities:
 - a. Before every game, a coin toss will take place at midfield involving the referees and at least one representative from each team.
 - b. Before the Championship Game, the singing/playing of the national anthem will take place prior to the coin toss.
2. The game consists of two 20-minute halves and a brief halftime (5-10 minutes). All games must be finished within 1 hour and 15 minutes of actual time. The game clock is subjected to the following guidelines:
 - a. The running clock only stops after touchdowns, field goals, changes of possession, or timeouts called by either team or the referee. The clock restarts on the referee whistle.
 - b. During the final two minutes before the end of either half, the clock shall also stop after running out-of-bounds, incompletions, penalties, turnovers, or first downs. The clock restarts on the referee whistle after first downs and penalties, but the clock will restart when the ball is snapped in all other cases.
 - c. **NOTE:** The Officials have authority to switch to a full running clock (can only be stopped by timeouts) for the remainder of the game in the event that either team is inefficient in their use of time during the first half.
3. The offense has 25 seconds, indicated by the play clock, from the time the referee spots the ball to initiate a play. The ball must leave the Center's control before the 25-second play clock expires. If the play clock buzzer sounds before a hand-off is complete, a 5' delay of game penalty will be assessed, marked from the line of scrimmage. The referees shall also call a false start penalty if a robot is jiggling or otherwise moving to finish the handoff to the QB.
4. Plays that begin in the possession of the Center are initiated the moment the Center releases the ball (not simply moves it).

5. Each Team is allowed 2 timeouts per half. Any member of a team may call a timeout, by saying "timeout," forming a "T" with their hands, and showing it to the referee. Each timeout lasts 1 minute. The 25-second play clock is started after the 1 minute has expired. A delay of game penalty results from a timeout called after all timeouts have been used, resulting in a 5' penalty marked from the line of scrimmage.
6. In case of a draw at the end of the game, NCAA rules for overtime are observed with each offense taking possession at the one-third line.

D. Offense

1. Robotic Football games, competitions, and events are played using a Micro Mini Football, which shall be inflatable, measure 6-7" in length, and not be made of hard plastic or solid rubber. The ball may not be significantly modified and must be pressurized to a pressure within the range stated on the ball. Each offense may elect to use their own ball for their possessions. Referees may confirm that the ball is unaltered and properly inflated at any dead ball. Violations will result in a 15' penalty and loss of down.
2. All Players with tackle sensors are eligible to run down field and catch passes.
 - a. Illegal Robot Downfield: A Center or Offensive Lineman may not materially cross the line of scrimmage on a pass play until the ball has crossed the line of scrimmage. Failure to comply results in a 5' penalty assessed on the Offense.
 - b. Ineligible Receiver: If a Center or Offensive Lineman retains a forward pass, a 5' penalty shall be assessed on the Offense.
3. After each play, a referee must be able to remove the ball from any Player without touching that Player or lifting that Player off the ground so as to spot it for the start of the next play. This rule does not apply to Quarterbacks unless the Quarterback advances the ball by rushing past the line of scrimmage, and it does not apply to Kickers or Defensive Players who do not advance the ball following a turnover. If a referee cannot freely access the ball, after one warning per half, that player will be ejected from that game only.
4. A pass is caught when any part of a Player contacts the ball before the ball touches the ground. This is referred to as a Touch Catch. If that Player retains possession of the ball and is equipped with a tackle sensor, the Player can advance the ball. This is referred to as a Retained Catch.
5. A field goal or kicked PAT is scored when the kicked ball passes over the goal post crossbar and between the goal posts.

6. If a field goal attempt is missed, the defending team takes possession of the ball at the point of the field goal attempt.
7. A Running Back or Wide Receiver may receive the ball directly from the Center (effectively running a Wildcat play) as long as the Quarterback is lined up as a receiver on the field. Violations will result in an “illegal formation” penalty, assessed by a 5’ penalty marked from the line of scrimmage.
8. Missing Robot Scenarios/Penalties:
 - a. Case 1:
 - i. Scenario: Teams may run out of operational robots and are unable to field a line of 8 on Offense or Defense. In the event that all Quarterbacks and/or Centers are unavailable on Offense, Rules 8.b-8.d apply where appropriate.
 - ii. Penalty: Offenses are restricted to 1 Quarterback and 1 Center on all plays. Defenses cannot use Quarterbacks or Centers on any play. The Team can still compete but is limited to the number of available robots that are safe to operate.
 - b. Case 2:
 - i. Scenario: Teams may elect to have the ball start on the Quarterback in the event of Center malfunction.
 - ii. Penalty: This results in the loss of 1 Player (Center) on that play and the inability to earn any Robot Points or Automatic First Downs on retained catches for the remainder of the current drive (See Scoring Document for details).
 - c. Case 3:
 - i. Scenario: Teams may elect to have the ball start on a Running Back or Wide Receiver due to both the Center and QB being inoperable.
 - ii. Penalty: This results in the loss of 2 Players (Center and QB) on that play and the inability to earn any Robot Points for the remainder of the current drive (See Scoring Document for details).
 - d. Case 4:
 - i. Scenario: Teams may elect to have the ball start on a Running Back or Wide Receiver due to the Center being inoperable and the Offense running a Wildcat play.
 - ii. Penalty: This results in the loss of 1 Player (Center), the QB must be lined up as a receiver on the field per Rule B.7, and the inability to earn any Robot Points for the remainder of the current drive (See Scoring Document for details).

In all situations with no Center snap, the robot starting with the football must line up in the Quarterback position as if the Center were still present (a Lineman can move into the position to protect the QB/RB/WR from pass rush). The Human operator of the QB/RB/WR must yell “SNAP!” to initiate the play.

Failure to comply with any of these requirements will result in an “illegal formation” penalty, assess by a 5’ penalty marked from the line of scrimmage.

NOTE: The Officials are authorized to assess this penalty if they feel the Human operator is not clearly initiating the play as directed.

E. Defense

1. Exactly three defensive players must line up within two feet of the line of scrimmage and within three feet on either side of the ball. This rule deviates from NCAA rules, however, it is necessary to help allow the offense to develop a passing play. The remaining 5 defensive players must be at least 10’ back from the line of scrimmage until the play begins, at which time full rush is allowed. Violations will result in an “illegal formation” penalty, assessed by a 5’ penalty marked from the line of scrimmage.
2. Passes contacting the Defensive Players will be considered deflected and not intercepted unless the player retains the football and is equipped with a tackle sensor. In this scenario, the Player can advance the ball
3. No significant contact is allowed between the offensive pass receiver and a defender, where “significant” will be judged by the referees to mean anything that impedes the free movement of either Player. The Player initiating the significant contact will be charged with pass interference. Defensive pass interference results in an automatic first down and a 10’ penalty marked from the spot of the foul. Offensive pass interference results in a loss of down and a 15’ penalty marked from the original line of scrimmage. Pass interference penalties will only be called on plays in which the ball starts in or is transferred to the Quarterback, so run blocking that results in a tackle will not constitute an interference penalty.
4. Tackle Rule: A tackle is defined as a triggering of the sensor light and contact by a Defensive Player. If the sensor light on the ball carrier turns on for any other reason, the referee shall not stop the play.
5. Forward Progress: The referees shall call forward progress when a ball carrier is so held that its forward progress is stopped. The ball is spotted where the ball carrier was located at the moment of the whistle.

F. Additional Offensive and Defensive Penalties

1. There is a 4” neutral zone on either side of the line of scrimmage. The only Player allowed in the neutral zone before a play is initiated is the Offensive Center. A Lineman is offside when it breaks the neutral zone prior to the snap, even if no contact is made with the opponent. The penalty is assessed by a 5’ penalty marked from the line of scrimmage, and the down is replayed.

2. If the Center retains the ball after the first attempt to snap it to the intended Player, a 5' false start penalty shall be assessed.
3. The Offense must have at least 4 Players within 1' of the line of scrimmage at the start of the play. The 4 Players can be anywhere on the field laterally. Violations will result in an "illegal formation" penalty, assessed by a 5' penalty marked from the line of scrimmage.
4. Illegal Hits will result in a 5' penalty and automatic first down (or replay of down if committed by the Offense) under the following circumstances:
 - a. General Roughing: A "roughing" penalty occurs when the offended Player is physically damaged. **NOTE:** The Officials have authority to disqualify an equivalent Player on the offending team or require the offending team to forfeit the game in extreme situations (e.g. continuous targeting and destruction of opposing robots).
 - b. Roughing the Passer: After the ball is released by the Quarterback, there may be no significant contact between the Defense and the Quarterback as result of the motion of the Defensive Player.
 - c. Loss of Control: A Player has been driven at full speed into a barrier or wall or the referee determines that a Player has been operated without regard to safety. Intent does not have to be established. This Player is also issued a warning and subject to Rule A-5c.
5. Kicker Ball Placement: After driving the kicker remotely onto the field of play, the kicking team may elect either option:
 - a. Human operator may place the ball on the kicking tee, manually release any safety mechanism, and then move the kicker remotely 5' to the final kicking position.
 - b. Human operator may first drive the robot 5' into its final kicking position, place the ball without touching or moving robot, and then remotely release any safety mechanism.Either option above prohibits all human-to-robot physical contact after the robot has been remotely moved to its final position. If human-to-robot contact is detected, referee shall call a 5' illegal procedure penalty.
6. Taunting or verbal abuse by humans will not be tolerated. The first offense results in a warning to the individual. A second offense results in a 20' penalty for unsportsmanlike conduct. A third offense results in immediate ejection from the game.
7. To protect the human operators on the field, an "unsportsmanlike" penalty of 5' and replay of down will be assessed under the following situations:

- a. Any of the Human operators on the field or any robot crossing the Safety Boundary shall be called for a safety violation (see Rule B.13).
- b. If a Defensive Player gets closer than 5' to a human offensive operator on the field, the Defense shall be called for a safety violation.
- c. If Human operators on Offense venture into the Defensive side of the ball, thereby interfering with the defensive line, the referee shall first issue a warning. If occurring a second time, the Offense shall be called for a safety violation.

Technical Appendix

The following pieces of equipment are required items:

1. Kill switch:

- a. It is recommended that you use a lever type battery cut-off switch made for automotive applications. The kill-switch must be readily identifiable and colored red. A good example can be found at <http://www.pegasusautoracing.com/productdetails.asp?RecId=4913>.
- b. The switch cannot have a removable key, such as in the kill-switch found at <http://www.pegasusautoracing.com/productdetails.asp?RecId=1465>.

2. Base-plate bumper material:

This will consist of a hollow bulb P-strip of extruded Ethylene Propylene Rubber (EPDM) acquired from Wefco Rubber Manufacturing Company, Inc. The part number is #4134, and the detailed dimensions can be found at http://wefcorubber.com/extrusions_industrial_pstrips.asp. The nominal stem thickness is 3/32 inch, and the nominal bulb diameter is 9/16 inch. The stem of the bumper must be bolted in a rigid fashion to the top or bottom of the base plate such that the hollow bulb is in direct contact with the 1/2-inch thick outside surface of the base plate. In this way, the hollow bulb will be the contact material for any contact with other Players. Bolts must be placed at least every 3.25 inches as measured along the perimeter of the base plate and may not be threaded directly into the base plate (thru holes and nuts must be used).