Virtual Robotic Football Combine
Saturday, April 2, 2022
12 pm EDT (11 am CDT)

The Combine of the Collegiate Robotic Football Conference serves two purposes: first, as the proving ground for schools that wish to compete for the Robotic Football National Championship, and second, as a proving ground for emerging teams that wish to eventually field a full team and compete in games. The Combine consists of 8 events in which the schools will be competing for the best time or score.

Combine events are styled after the NFL Combine to test strength, agility, speed, and maneuverability. Not all events apply to all robots. To participate in the Combine, one needs a minimum of one functioning robot football player that will allow participation in some, but not all events. Teams begin at the same time and finish all events in 60 minutes.

This Robotic Football Combine will be conducted in-person and virtually for those unable to attend, with each virtual school streaming their participation via Zoom. The team with the highest aggregate score defined by their positional placement in each event across all competitions will win the Robotic Football Combine Championship (virtual competitors are not eligible). Some of the listed events may be cut for time as we further develop the schedule for the day.

1. 60-Foot Shuttle
2. 3-Cone Drill
3. Strength Test
4. Speed Test
5. QB Accuracy Test
6. Fumble Drill (recorded by the average of the 3 times rather than simply the best time)
7. Longest Field Goal
8. Longest Pass

There are eight cash prizes for the in-person participants in the Combine, each worth $250, for the team that achieves the best score in each event. Established teams (ND, ONU, Valpo) may win only one prize, determined by the order above. Any prizes after the maximum shall be awarded to the next best score in that event.

Changes to the Combine are detailed throughout this document but will be summarized here. The biggest single change is that instead of a shotgun start with each team being given six minutes to finish each event, rotating from event to event, teams will be assigned an initial event and then free to circulate in any order to the

other events, or even to participate in two events simultaneously if space is available. In all events, teams will be given three attempts rather than 6 minutes to complete, the score recorded (either an average or the best score, depending on the event). To enforce order and fairness, volunteers at each event are responsible to make sure teams clear the area and keep circulating. The timer will count down the hour available for this event and sound a horn when time has run out.

Teams are required to submit a roster of their competing robots and humans the night before (see the next page). Please email these by 5 pm Friday, April 1, to Michael Zachariades at michael@collegeroboticfootball.org.

The only new event is the Longest Pass event by the QB; all other events have been run in previous years. Events that have been adjusted include the Fumble Drill and the QB Accuracy Drill. The Fumble Drill will judge the average of a team's attempts rather than the best time to help mitigate luck in the event. See more in Drill #6 below.

The QB Accuracy Drill has been reduced to a 2-minute period rather than a 6-minute period, though teams can run the 2-minute drill once each for the QB, C, and WR for a total of three 2-minute periods. This change allows each team three 2-minute periods to get their best score from any of their three 2-minute periods recorded. Teams have the option of running those three 2-minute periods serially.

This event will additionally include two new measurements, one for the Wide Receiver and one for the Center. These measurements do not change how the event is performed or scored for the prize. The difference is that the WR and C will be measured on their individual performance in addition to being measured as a system as the event has historically been run. How they are measured is detailed in Drill #5 below. As this is experimental, only the QB score counts toward the prize. The C and WR scores will be kept so we can evaluate these changes to the event.

Robotic Football Combine Drills

TITLE	POSITION	TESTS
1. 60-Foot Shuttle	Linebacker	Speed and controllability
2. Three-Cone Drill	Defensive Back	Agility, maneuverability
3. Strength Test	Offensive Lineman	Strength and power
4. Speed test	Running Back	Pure speed
5. QB Accuracy Test	QB, C, & WR	Throwing precision/accuracy
6. Fumble Drill	Defensive End	How fast defense can recover fumble
7. Longest Field Goal	Kicker	How far kicker can kick accurately
8. Longest Pass	Quarterback	Deep throw

Every Robot & Driver combination completes the Combine events based on the position for which they are submitted. This year's Combine will feature a more individualized design. This tests the holistic nature of the robotic roster and the human driver roster of a team. Teams must submit a Robot & Driver for each of the following positions in the format of this table by April 1st at 11:59pm Eastern to the CRFC.

POSITION	ROBOT NAME	DRIVER NAME
QB - Quarterback		
C - Center		
RB - Running Back		
WR - Wide Receiver		
OL - Offensive Lineman		
DL - Defensive Lineman		
LB - Linebacker		
DB - Defensive Back		
K - Kicker		

The rest of this document describes each of the Combine events in detail.

#1 Drill: 60-foot Shuttle (Controllability Test)

Purpose: Measure the ability of the robot to shuttle (reverse direction) in a controlled but speedy manner.

Equipment Required: 30 small orange cones, floor tape.

Description: The drill consists of a start line and a finish line halfway in a rectangle 3 x 30 feet. (See Figure 1.) A straight line, marked by tape, is placed 15' from either end, marking the start and finish line. Starting from a standing stop, the robot must shuttle to one end, reverse direction, move to the other end, reverse direction again, and cross the finish line. The time to perform that action shall be measured in seconds. The timing official will measure the time and count the number of times the robot touches either side boundary line (called an infraction). One second shall be added for each infraction.

A run is immediately disqualified if the robot exits the area between the two lines of cones and doesn't immediately return. A minimum of three runs is required to register a score. Only the best score is kept.

Measurement: The time taken to shuttle from the starting line to the finish line in the lane.
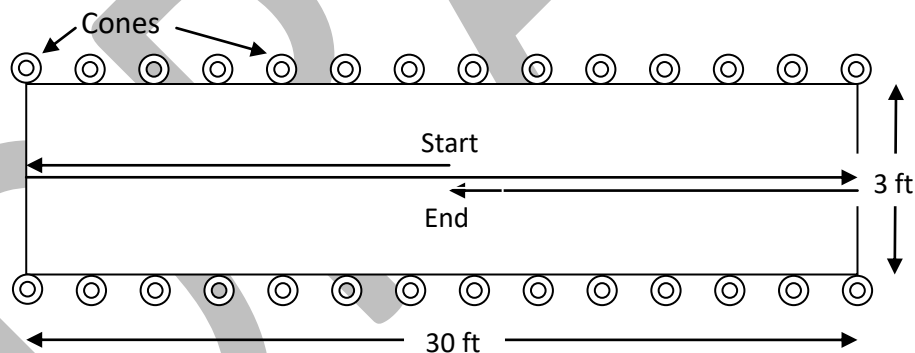

Figure 1. *Setup for the Controllability Test*

Record:

	School	Robot #/Name	Driver Name	Time (secs)	Penalties +1 pt/cone hit	Score
1						
2						
3						

#2 Drill: Three-Cone Drill

Purpose: This drill tests the maneuverability and agility of the robot.

Equipment Needed: Three large orange cones, floor tape

Description: As in an NFL combine, this drill consists of 3 cones in an L-shape and spaced 15 feet apart center-to-center. The robots start and finish on either side of cone #1. See figure 2 for the path around the cones (the path shown is illustrative and approximate). The robot will start from rest at cone #1 with its leading edge just behind the start line. The path is timed from when the robot begins to cross the start line to when its leading edge crosses the finish line. A successful path is one that negotiates a nearly 360° turn (cone #2), a 180° turn (cone #3), and a roughly 90° turn (cone #2).

Measurement: The time required, in seconds, to travel from the start cone along the path in Figure 2 to the finish line, with one second added for each time the robot touches a cone with any part of its surface. Officials or teammates replace hit cones as needed.
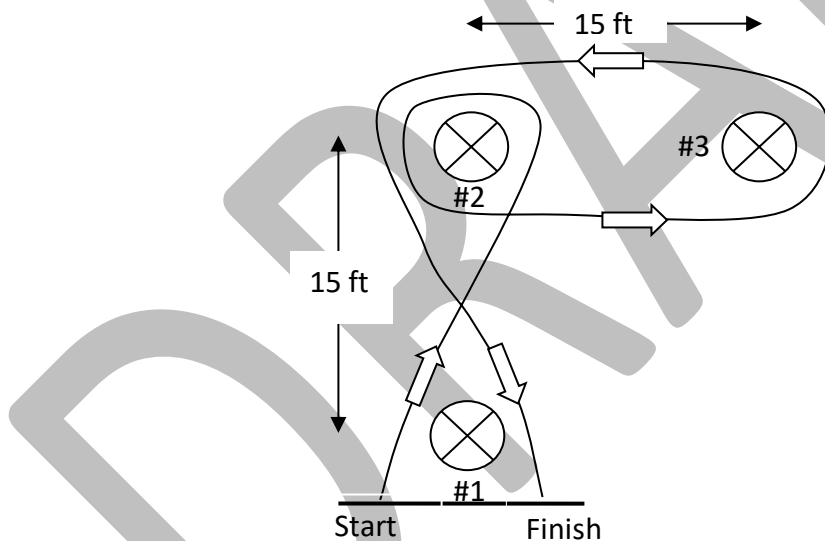
Figure 2. *Three-Cone Drill*

Record:

	School	Robot #/Name	Driver Name	Time (secs)	Penalties +1 pt/cone hit	Score
1						
2						
3						

#3 Drill: Strength Test

Purpose: This drill tests the overall strength of the robot, similar to a bench press.

Equipment: A dummy robot lineman (no motor) on coasters, floor tape. The dummy robot has a pole in the center around which weights (like those used in gyms) are placed to add mass and therefore inertia.

Description: The robot will start from rest in contact with a 45-lb weight on a box with four free-wheeling dummy robot. Without using momentum, the robot must overcome the dummy robot's inertia and push it a distance of 10 feet. If the robot successfully completes the task, another 10 lbs. is added to the stack. This process is continued until the robot fails to move the stack across the finish line. The robot must start from rest barely touching the dummy robot to take momentum out of the test. See Figure 3 for a diagram. The robot does not have to follow a straight line, but the weights may or may not be ideally symmetrical on the dummy robot, so control is a factor.

Measurement: The highest weight in pounds that can be negotiated across the finish line.

Start   Finish

Robot   Weight

90°

⟵   10 feet   ⟶
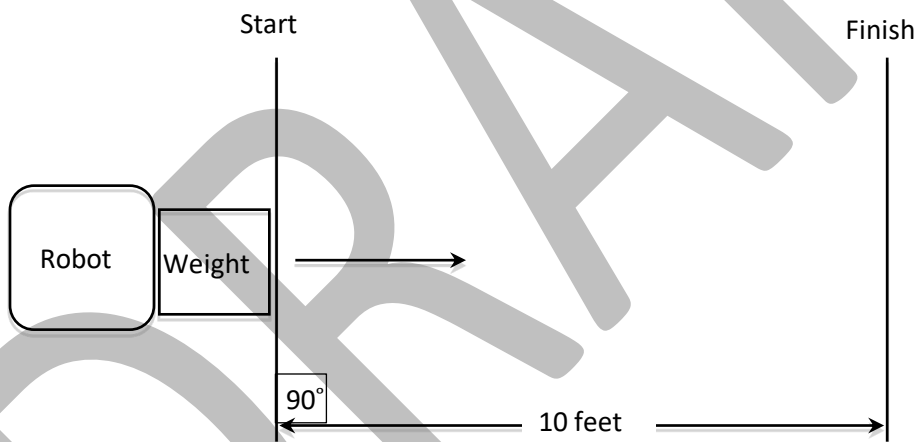
Figure 3. *Strength Test Setup*

Record:

	School	Robot #/Name	Driver Name	Weight (lbs)
1				
2				
3				

#4 **Drill**: Speed Test

Purpose: This drill measures pure speed.

Equipment: Floor tape; a barrier to prevent a failure to decelerate after crossing the finish line may be necessary, depending on available space.

Description: A robot runs the length of a roughly 60-foot lane and is timed, starting from a dead stop. There is no penalty for deviating from the lane or a straight line, as the recorded time will necessarily reflect any departure from a straight line, but safety concerns demand that the lane and the area around it be kept clear during this event.

Measurement: The time in seconds taken to run the lane from start to finish.

Record:

	School	Robot #/Name	Driver Name	Time (secs)
1				
2				
3				

#5 **Drill**: QB Accuracy Test

Purpose: This drill tests how accurately the Quarterback can throw to a specific location, how consistently the Center can snap the ball, and how effectively the Wide Receiver can retain a pass.

Equipment: Floor tape

Description: Nine "X" marks are placed on the floor at distances of 6, 12, and 18 feet and at roughly 45 degrees from a line where the QB is stationed. The Center is on the other side of the line in position to hand off to the QB. The WR is maneuvered remotely so that it sits over an "X". The quarterback passes to the wide receiver. If the football hits any part of the receiver but is not caught, the QB is awarded 1, 2, or 3 points for 6′, 12′, or 18′, respectively. The score is doubled (2, 4, or 6 points, respectively) if the wide receiver truly catches the ball. No points are awarded for a miss. If the Center is inoperable or missing, the scoring is halved. Once a catch or touch-catch is made, the WR must move to another "X" **and no "X" may be repeated until a non-zero score is achieved for each "X".** See Figure 4 for a diagram of the drill. If a completed pass is accomplished for each "X", the team may start again for additional points. The team will have 2 minutes to score as many points as possible. They will three 2-minute attempts in total to score their best scores for submission.

Measurement: The accumulated scores for completed passes in the time allotted. For the WR, the percentage of retained passes over total catches (including touch catches). For the Center, the percentage of successful snaps (defined as a snap after which the QB was able to get a pass off unaffected by the snap) over the total number of snaps.
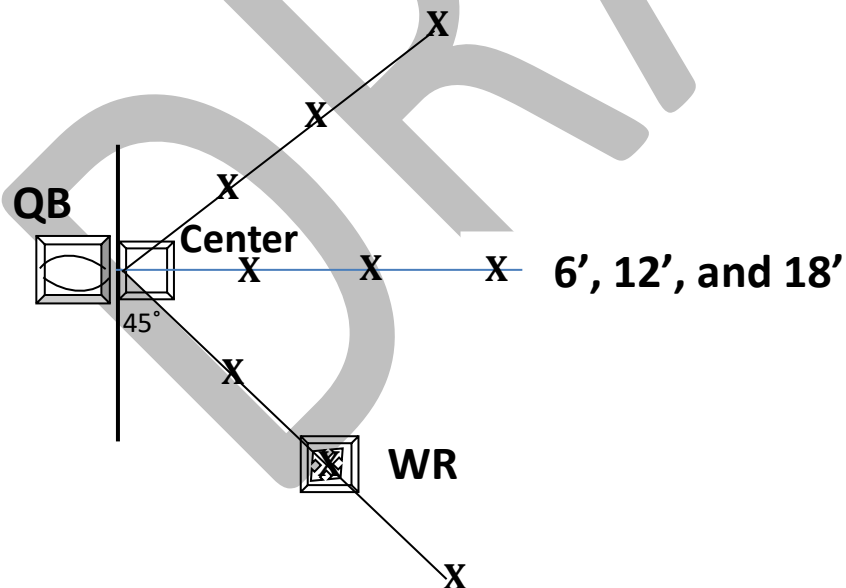

Figure 4. *Quarterback Passing Accuracy Test*

Measurement tables are on the next page.

Measurement for Quarterback: The accumulated scores for completed passes in the time allotted.

School	Robot #/Name	Driver Name	Points 1-short; 2-med; 3-long	Halved if hand-fed	Score
1					
2					
3					

Measurement for Center: The total number of successful snaps divided by the total number of snaps as a percentage. A successful snap is defined as a snap that leads to the Quarterback passing the ball. If the Quarterback is unable to pass the ball after the snap due to the failure of the Center or the placement of the ball in the QB, that is considered an unsuccessful snap.

School	Robot #/Name	Driver Name	Successful Snaps	Total Snaps	Percent Score
1					
2					
3					

Measurement for Wide Receiver: The total number of retentions divided by the total number of touch catches as a percentage. A retention is defined by the WR possessing the ball after the ball has come to a stop. A touch catch is any pass that makes contact with the WR. This will measure how effectively the WR design can retain passes that come within its cross-sectional area.

School	Robot #/Name	Driver Name	Retentions	Touch Catches	Percent Score
1					
2					
3					

#6 Drill: Fumble Drill

Purpose: This drill tests the ability of a driver to recover a ball that has been fumbled onto the ground.

Equipment: Floor tape

Description: An official (a non-student) drops a football onto an "X" on the floor from roughly five feet above the "X". Upon the ball contacting the floor, the contesting robot, which must start behind a line 10' from the "X", attempts to recover the ball by making contact with it.

Measurement: Record the time in seconds from when the ball makes contact with the floor to when the robot "defender" makes first contact with the ball. If the robot picks up the ball (rather than just contacts it), two seconds are subtracted from the score. The average time of the three is kept.
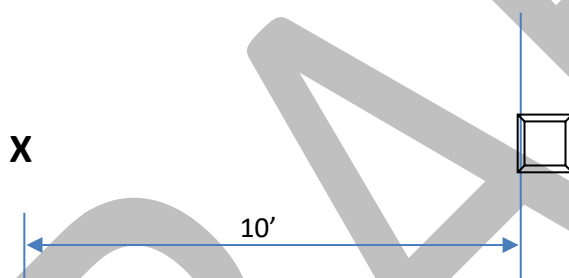
X

10'

Figure 6. *Fumble Drill*

Record:

	School	Robot #/Name	Time (secs)
1			
2			
3			
AVERAGE			

#7 Drill: Longest Field Goal

Purpose: This drill tests the furthest distance a kicker can kick a field goal

Equipment: A single set of goal posts; sufficiently long measuring tape

Description: The kicker lines up at the distance of the operator's choosing from the field goal posts. Each successful kick that passes through the uprights should be measured and recorded.

Measurement: The distance from the ball's placement in or in front of the kicker to the goal post as measured along the floor perpendicular to the goal posts. Furthest distance is kept of the three attempts.

Record:

	School	Robot #/Name	Distance (ft)
1			
2			
3			

#8 Drill: QB Longest Pass

Purpose: This drill tests the throwing strength of a Quarterback.

Equipment: Floor tape, measuring tape

Description: The Quarterback lines up at the line of scrimmage as defined by the floor tape. Each throw should be measured and recorded.

Measurement: Measure the distance from the line of scrimmage perpendicularly to the spot where the ball first contacted the ground. The drill is executed three times and the highest score is considered.

Record:

	School	Robot #/Name	Driver Name	Distance (ft)
1				
2				
3				

Sample Layout of Combine Events

Field Goal Posts

Finish

30'

60'

X

X

X

45°

X   X   X

6'   X

6'   X

6'   X

#5: QB Accuracy

#6: Kicker Speed & Accuracy

50'

#7: Longest Field Goal

Start

#4: Speed Test

#8: Longest Pass

QB

Finish

#3: Strength Test   10'

Start

#8: Longest Field Goal (kicker placement)

#6 Fumble Drill

15'

15'

20'

Start   Finish

#2: 3-Cone

#1: 60' Shuttle

30'

Place ~15 small cones on each side boundary

3'