

MECHATRONIC FOOTBALL COMBINE PROPOSAL

PROJECT 3: PART 2

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1. INTRODUCTION

The purpose of this project was to develop design requirements for players of a proposed second-generation mechatronic football game. The result is a detailed framework for a player combine, including performance criteria, testing processes, and a plan for the logistics of the combine.

2. BASIC PERFORMANCE CRITERIA

2.1. **Speed.** Football is a game of quickness, therefore making speed a vitally important quality of players. Quarterbacks use speed to avoid sacks, running backs use speed to “turn the corner,” wide receivers use speed to “blow the coverage” and get open, and defensive linemen use speed to get around the offensive line and sack the quarterback.

A 40 *ft* dash will be used to evaluate speed. Each player will be timed. Obviously, comparing the speed of a lineman to the speed of a receiver is nonsensical since each position has different roles. Therefore, each recorded time will be compared to a target value, which is specific to position. Target times are listed in Table 1.

TABLE 1. Target Times for Speed and Maneuvering Tests

Position	Speed Test [s]
Quarterback	10
Running back	9
Wide Receiver	8
Linemen	12

2.2. **Straight Line Control.** A major issue in the previous mechatronic football game was the robots being unable to maintain a straight line on breakaway plays. To examine the abilities of the robot to move in a straight line, an additional measurement will be taken during the 40 foot dash. The left/right displacement of the robot from its initial position as it crosses the finish line will be measured. This value will be reported as the left/right displacement divided by the 40 feet it traveled. Based on the previous robots, a target is 1 ft/40 feet.

2.3. **Tackling Force.** Being able to generate a sufficient tackling force is a critical robot capability. The goal for this test will be to create an impact 1.5 times that required to set off the tackle sensors. To test this, the robot must run into an accelerometer or tackle sensor, starting from rest three feet away from the sensor.

2.4. **Turn Rate.** Another category of criterion is zero translational velocity turn rate. Because the robots are relatively small, angular velocity becomes critical in situations where the robots have to interact in close quarters. Given the maximum speed defined above, a standing quarterback robot should be able to turn and track another robot which is at maximum velocity and located a distance of one meter from the standing robot. For non-quarterback robots this standard is reduced by twenty percent. This dictates a minimum possible angular velocity of 4.4 radians/sec for all robots with quarterbacks required to operate at 5.6 radians per second. To test this, the robots will start from rest and have to spin around 5 times in a target time of 5.6 seconds.

3. POSITION SPECIFIC CRITERIA

3.1. **Passing & Receiving: QB / WR.** The passing drills will test the throwing skills of the quarterbacks while simultaneously testing the catching ability of the wide receivers. The quarterback will remain in the same spot and for the short passes, wide receivers will line up at distances of 5ft, 10ft, and 15ft away from the Quarterback. For the long passes, the wide receivers will line up 20ft, 30ft, and 40ft away from the quarterback. Each quarterback will attempt four throws for each of the six distances, for a total of 24 throws. Number of completed passes vs. attempted passes (and

the distance of these passes) will be noted. It should also be noted for the incomplete passes if the ball was thrown incorrectly or if the wide receiver failed to catch a good pass.

3.2. Acceleration / Change of Direction: RB / WR. As a running back or wide receiver, having quick acceleration (or bursts of speed) is extremely beneficial. With a fast acceleration, a running back or wide receiver can quickly stop and change directions to avoid being tackled. Also acceleration is helpful directly after a handoff when the running back is supposed to find the hole that the offensive line has made.

This test is yet another test of time. As shown in Figure 2, the player lines up next to a line. Each player will be timed as it makes two trips back and forth between the two lines that are separated by 3 ft. Every instance the player fails to completely cross the line, a 1 s penalty will be added to its time. The target time is 8 s.

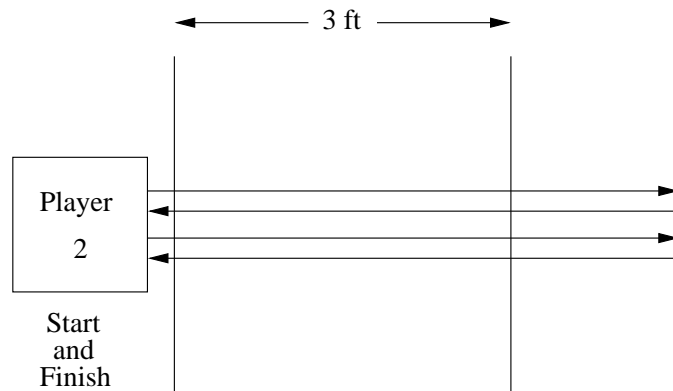


FIGURE 1. Diagram of the Acceleration test

3.3. Punt, Pass, and Kick Drill: QB, PK, P. The final event is called the punt, pass, and kick drill which is modeled after the NFL Youths Punt, Pass, and Kick competition (PPK). This competition will be a drill to test quarterbacks and kickers and to gain knowledge of how these aspects of the game will work during the game. This final drill will take place on the entire field and will require the entire field to be clear during the event. Down the middle of the field there will be a centerline to measure the accuracy of the punts, passes, and kicks during the event. The set up

is shown in Figure 3 and is intended to help imagine how the scoring of this final drill is conducted. To punt and kick, a kicking robot will be set up at one end of the field and will kick the ball as far and as straight as possible to accumulate points. To score when throwing, the quarterback robot will also be required to throw the ball as far and as straight as possible. The total score of this event is equal to the distance each punt, pass, and kick travels down the field minus the distance each deviates from the centerline. For example, if a punt travels 35 feet but is 10 feet away from the centerline then the total score for that kick is 25 feet. Each team will be allowed 2 punts, 2 passes, and 2 kicks to accumulate points. The target value for the sum of these attempts for each team is 150 feet.

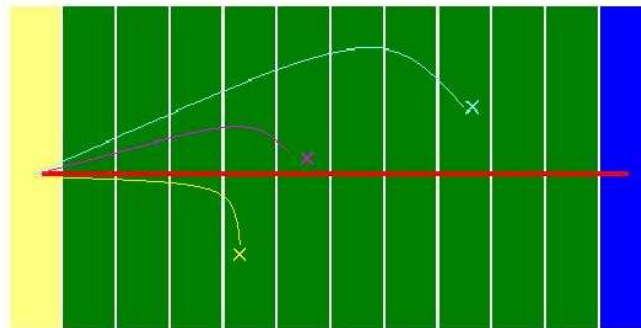


FIGURE 2. Punt, Pass, Kick Drill

4. FRAMEWORK AND PLAN

4.1. **Timing.** The entire combine must be completed within a three-hour time limit. To accomplish this, all tests will be running simultaneously, except the Punt, Pass, and Kick drill which will be performed last. Also, both teams will be participating in tests simultaneously. As a guideline, but not a requirement, all specialty robots will start at their respective advanced criteria tests. All other robots will begin at the basic criteria tests. After completing a test, the robot is free to go to any test next, based on the line length. This system will allow for freedom and would be the fastest way to complete the combine.

4.2. **Organization.** During the combine, robots from both teams will be mixed together instead of being divided into teams. This organization will make the combine be more individual for each robot, similar to the NFL combine in which prospective players are not yet on teams. Each testing setup will be spread out throughout the venue, and robots will be free to move between tests. Specialty tests will be grouped together for convenience.

4.3. **Student Responsibilities.** All students will need to be involved in the combine. Each person will have a specific important role.

- **Robot's Agent:** Each robot will have one student from the robot's team to serve as its agent. The agent will control the robot through each test. Also, the agent must keep track of the robots progress. The agent will carry and complete a print out of a completion form that records the robot performance in each test.
- **Tester:** Each test will have at least two testers, one from each team. The testers responsibility is to make sure the test runs quickly, smoothly, and fairly. The tester must also take measurements and initial the agents completion form to acknowledge that the robot completed the test.
- **Officials:** At least two students from each team will be officials. The officials will oversee the entire combine. They will address any issues that agents or testers might have. They will help to direct agents to the appropriate tests. The primary responsibility of the officials will be to make sure the event runs properly and on schedule.

5. REFERENCES

Second Generation Rules:

[http : //www.nd.edu/ batill/www.ame30362f09/Rules_Second_Generation_AS_POSTED.pdf](http://www.nd.edu/batill/www.ame30362f09/Rules_Second_Generation_AS_POSTED.pdf)

First Generation Running Back:

[http : //www.youtube.com/watch?v = W29jy2TvMwo&feature = related](http://www.youtube.com/watch?v=W29jy2TvMwo&feature=related)

First Generation Football Game:

<http://www.youtube.com/watch?v=BDSg6EABxSU>feature = related

NFL Combine:

<http://www.nfl.com/combine/story?id=09000d5d806cf5e1>template = with - videoconfirm = true