Hand-timed versus Electronic-timed 40 Yard Dash

Results of an objective study to measure the differences of a hand-timed and electronic-timed sprint.

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An athlete's physical performance test results provide an important specification that often determines their future. Small differences in these performance numbers can make big differences in their career. The standard "Combine" tests have been the gold standard for objectively evaluating and comparing individual athletic performance. The annual NFL Scouting Combine is a vivid example of the importance athletic performance numbers are for teams and the general public. The 2013 NFL Scouting combine had over 7.25 million viewers[1]. An athlete's vertical jump and 40 yard dash times are discussion topics on countless TV programs, radio shows and water-cooler banter across America. For the professional athletes, their performance numbers measured at a combine often follow them for the remainder of their carrier. These performance numbers are extremely important objective measures of an athlete's training and natural-athletic capability.

The purpose of this paper is to:

> *Provide an objective analysis that quantifies the differences between a hand-timed and fully automated timed 40 yard dash.*

Hand Timing versus Fully Automated electronic timing:

Hand Timing:

Historically, coaches have used a hand-held stopwatch for measuring the 40-yard dash. Typically, the timing coach will stand at the 40-yard line. When the athlete leaves the starting line, the coach depresses the stop watch start button. When the athlete crosses the 40 yard line, the coach stops the time by depressing the same button. The time displayed on the stopwatch then becomes the athlete's 40 yard dash time.

Fully Automated Timing (FAT):

Several different Fully Automated Timing methodologies are used in the industry whereby the actions of the athlete will start the time and stop the time. To stop the timer, an electronic sensor which is viewing a special, non-visible light is often used. When the athlete's body blocks the light, the sensor sends a signal to the timing unit to signify an athlete has run past the line. This can happen in less than 0.0001 seconds. These are typically referred to as 'laser' sensors. Several different options are available to determine when the athlete starts the run, including:

- Pressure pad at the start line. A signal is provided to the timing unit to start the time when the pressure on the pad has been removed.

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1. NFL. (2013)."*NFL Scouting Combine Draws a Record Number of Views* ", NFL.com. Web: 3-1-2013

- Positioning a 'laser' sensor in front of the athlete. When the light in this sensor is interrupted by the athlete's body, the time starts.
- Positioning a 'laser' sensor at the start line. A signal is provided to the electronic timing system when the laser is not blocked.

The time result of a FAT 40 yard will almost always be greater than a hand timed 40 yard. In other words, the same person will have a 'slower' 40 yard dash result if they are timed using a fully automated system than a hand-timed 40 yard dash.

The majority of the time difference between the FAT and Hand timed 40 yard comes from the inherent human delay of starting the timer *after* the athlete initiates the run. In other words, the athlete will have started the run before the coach can depress the start button. Thereby, the hand-timed numbers always appear to be "faster" than electronic times. Furthermore, compounding the inherent variability of the hand-started times are differences between athletes, coaches, time of day, weather conditions, etc.

Although it is generally acknowledged by professionals that hand measured times are always "faster" than actual or electronic times, there have been very few disciplined studies conducted to objectively quantify this difference. One possible reason that an objective study has not been completed is the large number of variables that can have a significant effect on the results. These include: human factors (e.g., coaches response time, general health, focus, vision, etc.), environmental factors (e.g., moisture, ambient light, etc.) and the type of FAT system used for the comparison (primarily start method).

This study was designed to answer the following question:

What is difference between hand times and FAT times under the best possible testing conditions?

Although the statement: "best possible testing conditions" is inherently subjective, significant efforts were made to select a 40 yard test being conducted by a very reputable and experienced combine testing organization with defined procedures; with a highly-trained and highly regarded coach, and under ideal weather conditions. Furthermore, the FAT system used to measure the electronic time was the exact same equipment and process used in the 2011, 2012, 2013 NFL Scouting Combines and is planned for the 2014 NFL Scouting Combine. Although the other timing FAT start methods listed above are viable, the position start was selected because it is has been used at the NFL Scouting combine and anything different could bias the data. Also, the FAT electronics provided by Zybek Sports are tested and fully traceable to the Atomic Clock located at the National Institute of Standards and Technology located in Boulder, Colorado[2].

A 13 year Coach who represents an established athlete testing company was selected to establish the best possible baseline data set to quantify the difference and variability between hand and electronic timing. Arizona under ideal weather conditions.

Note: after collecting, analyzing and understanding the data presented in this paper, the athletic testing

[2] The atomic clock developed and located at the National Institutes of Standards and Technology located in Boulder Colorado serves as the United States' primary time and frequency standard.

company requested there be no mention of their name for fear of invalidating years of hand-timed 40 yard dash results. We have honored their request.

Test Procedure and Setup:

Extreme care was taken to not introduce any new variables for the combine event that could bias the data. To that end, Zybek Sports provided five independent timers (Figure 1) that were started at the exact same time by the position-start system used for standardized combine testing[3]. Figure 1 illustrates the timer configuration.

Figure 1 - System Illustration

Data Collection:

For each athlete the following was recorded:

- The Athlete Designator number
- Five Times:
  - Hand start time
  - 10 yard time
  - 20 yard time
  - 40 yd. times 30 inch gate height.
  - 40 yard time 50 inch gate height.
- A picture file number

Data Collection and Testing Process:

There were no changes to a standard combine and testing process for this test. Athletes were instructed to run the 40 yard dash, starting from a 3-point stance as done at the NFL Scouting Combines. Each athlete ran the 40 yard dash twice. The only difference in this combine was that the coach was provided a standard stop watch that had a wire connected to it. This wire was connected to one of the Zybek Sports timers.

Zybek Sports provided five (5) fully automated timing systems. All five of the timing systems were started when the athlete's hand is lifted from the start line upon the start of the run. This system is the same technology used for the fully automated timing system at the 2011, 2012, and 2013 NFL Scouting combine in Indianapolis. By using the position start sensor, the athlete initiates the time automatically without requiring any difference in the start technique.

[3] The Position Start begins the timing after the athlete lifts their hand and starts the run.

To measure the difference between the hand time and the electronic time, a signal wire was used to connect the stopwatch to electronic timer. The timer was started when the athlete left the start line and stopped when the coach at the 40 yard line depressed the start button. This method accurately measures the difference in the coach-started time and the fully automated start start time without introducing additional variables.

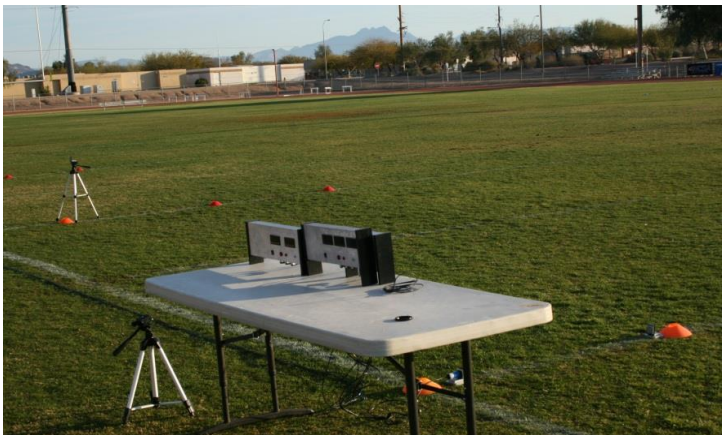

Figure 2 - Independent Timers

Hand Time v. FAT Time Data Analysis:

As detailed in the previous section, most variables were minimized or eliminated. The timer that measured the difference in the Hand time to the FAT time was started when the athlete lifted their hand and stopped when the coach at the 40 yard line depressed the start button on the stop watch. These times were recorded for all athletes both 40 yard runs. As illustrated in Figure 3, the measured differences between the hand held and the FAT timer ranged from 0.10 seconds to 0.25 seconds. As seen on figure 3, the time differences were evenly distributed between 0.10 and 0.25 seconds, with the average being 0.175 seconds.

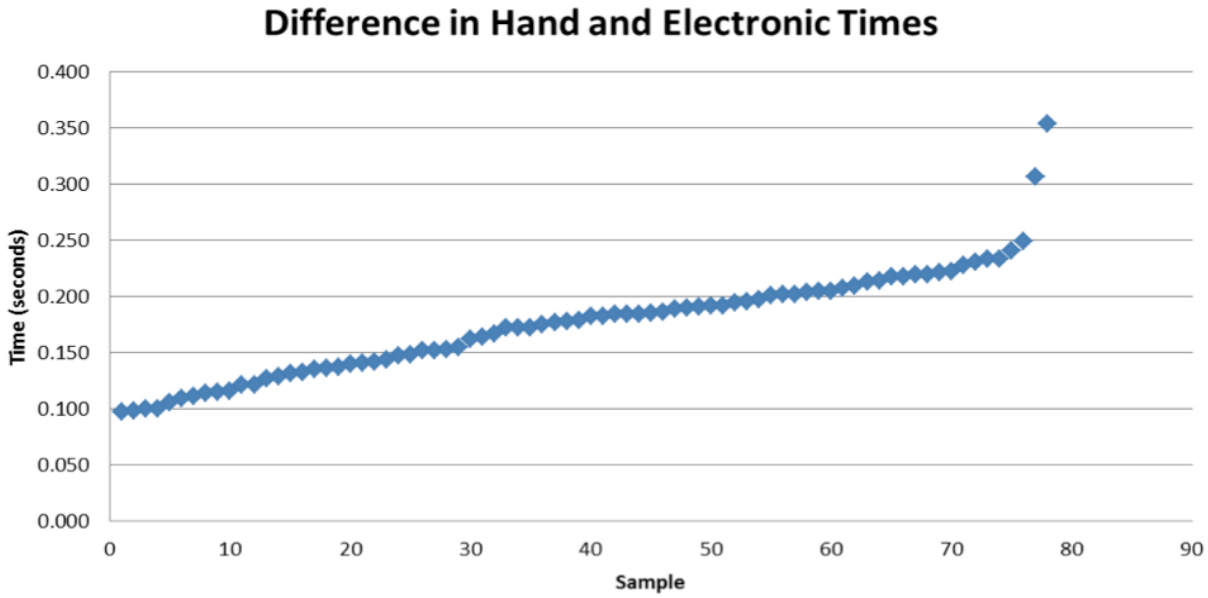

Figure 3 - Difference in the Hand and Electronic Times sorted by magnitude

From the data collected, it can be concluded that the delay between the hand start and the electronic start (when arranged by magnitude) is evenly distributed between 0.10 and 0.25 seconds. Therefore, based on this experiment data (and only accounting for human error at the start not the finish line), the average hand-timed 40 yard run is 0.175 + .075 seconds "faster" than a fully electronic time.

From the consistency of the discrepancy, and the highly controlled design of the experiment that used the best possible conditions and procedures, we believe this data can be considered a valid representation of the minimum error that occurs when using hand timing the 40 yd. dash for scouting combines. In situations where a testing organization is used that does not have established procedures or highly trained coaches, and near-perfect environmental conditions this data may in fact underestimate the true error that takes place at hand-timed test events around nation.

Upon initial inspection a 0.175 ± 0.75 error can appear inconsequential, however, in a sport such as football 1.1 million athletes are competing for 69,600 collegiate spots thus making performance-testing data critical in determining an athlete's future[4] [5]. For such a hypercompetitive field such as football the difference between a 5.0-second and 4.8-second 40 yd. for the 40-yard dash can significantly alter an athlete's trajectory. Additionally, in order to continue providing NCAA Colleges with the best prospective athletes, a 0.175 second error bound for the yd. dash is evidence enough to encourage standardization in Scouting Combines.

Conclusions:

There are 6.9 million High School athletes in the United States that are competing for 450,000 College positions[4]. Presenting accurate and consistent data from standardized combine testing is an increasingly important as the number of competitors continues to grow and as modern training methods are expanding the bounds of athletic potential. The error from hand timing results in a minimum of 0.1 to 0.25 second difference from electronic timing. The 1.75 ± 0.075 second variance should be considered if hand timing is being used for ranking athletes. Finally, accurate and repeatable testing data provides a training metric that can be used for improving the combine scores. Minor improvements in an athlete's score can make a big difference in their future.

[4] Frollo, Joe (2011). USA Football. "*Football Remains No. 1 Among High School Participation*". USAfootball.com. Web: 12-27-2013

[5] 1.1 million athletes competing for 69,600 collegiate positions means only 1 out of 16 will make the team.

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