On the Firing Line (Forty-eighth in a series)

Statics & Dynamics – Part 1

"That which is Still has Movement.
That which Moves has Stillness."

Target shooting is a sport rich with varied disciplines and breadth of related topics. Aspects of the sport appeal to engineers and technicians, while other aspects appeal to those who are much more metaphysical in outlook. Some disciplines require a great deal of movement and action, while others require incredible stillness.

Within the Olympic disciplines, there is the stillness of the extreme precision rifle and pistol events on one hand and the rapid, yet precise movements of rapid fire pistol and shotgun. Modern Pentathletes spend most of their time in physically demanding events and then must learn the mental and physical control of precision air pistol. Biathlon athletes face the ultimate contrast: pounding up the hill to the firing line on cross-country skis, then having to draw upon the inner (and external!) calm of the precision rifle athlete.

Even in the "calm" precision events there often is a whole lot of "action" as the athlete works to calm their mind and body… and pounding heart! Just ask a free pistol athlete… or a shotgun athlete facing their next target with 24 busts already recorded.

As we learn and train in our chosen discipline and events there are a great many factors to understand and master. One cannot possible learn everything at once; much less master every aspect all at the same time. An Olympic champion typically has a journey of 8 to 10 years or more under their belt. Some journeys are shorter and many are longer.

Because all the various items of information and techniques cannot be mastered at once, we break things down into manageable chunks. For example, we do not start a dialogue on the finer points of trigger control and shot release with an 8 year old, or 28 year old, who is being introduced to shooting for the very first time.

Often there is a missing link in our training. Often we fail to link together the disparate pieces of knowledge and technique into a cohesive, comprehensive whole. Instead we have a patchwork – and do not even realize this has happened. This is very frustrating to say the least.

"Everything Affects Everything"

We typically think in static terms, that is, we think about one variable at a time and in a static or fixed mode. This is a natural outcome based on breaking things down into manageable chunks, and especially based on our tendency to deal primarily with what we see before us. In reality, when we shoot there are thousands of variables, many unseen and un-sensed, all changing moment to moment together, much like an orchestra. The trick, of course, is to get all the instruments tuned together, the musicians well trained, and all "on the same page" in order to produce beautiful music!

Many athletes have heard "Everything Affects Everything" during their training. The coach is reminding them that even the simplest of changes can affect more than the one thing

they are working to adjust and to be sure to fully evaluate the adjustment. There are no "quick fixes" when striving for ultimate performance.

A common example of one adjustment affecting more than one component is a popular method of adjusting natural point of aim (NPA) when shooting rifle in the standing position. Athletes are taught that one method to adjust their NPA horizontally is to adjust where their back foot is pointing. By making subtle adjustments they can move the NPA to the left or right. Without a doubt, this does have the desired effect and so is commonly taught and used. The challenge is that, whether the coach or athlete realizes, this also affects the athlete's balance and stability. Those who understand the dual effect know that they have to work everything out so that they get the desired NPA and the optimal balance. Working on one aspect affects the other so this must be taken into account. Despite the stillness of a well optimized standing position, it is a dynamic system, not a static system. Understanding these effects helps an athlete optimize their performance. Be sure to think dynamically in addition to thinking statically.

Shooting Between Heartbeats?

We sometimes read about athletes releasing their shots between heartbeats – most typically in the popular press. Certainly heartbeat is one of many things going on inside our body as we shoot. Can athletes shoot between heartbeats? Do they? Can they "time" the shot to do so? The majority of athletes likely do, whether they know it or not and whether they can actually tell or not. There is a natural internal rhythm that occurs as we shoot that typically results in the shot releasing between the heartbeats without any active "control" or awareness of such on the part of the athlete. Thus, the shot timing between heartbeats is an effect, not an active decision in most cases. This is a hot topic of debate which will not be fully explored here, and there are many varying opinions.

Leaving aside the debatable aspects of the topic, there are interesting aspects to ponder. One Olympic athlete was known for having a very high pulse rate in finals. Her national team coach at the time indicated that her pulse rate was typically 160 beats per minute in finals. Yes, almost 3 beats a second! She was very consistent and shot many strong finals in her career, including in the Olympics, by trusting her rhythm and ignoring her racing heart rate. With that high rate, one wonders where in the heartbeat cycle her shots actually released.

Many prone specialists, and others, strive for a low resting pulse rate to improve their shooting. This can be beneficial to the majority of shooters, as long as they do not take it too far. An exceedingly low resting pulse rate results in a very large amplitude to each pulse which causes a larger disturbance to the sight picture. As with most aspects of shooting… all good things in moderation. Thinking statically, one strives for the lowest possible resting pule. Thinking dynamically, one considers both the frequency and the amplitude to reach an optimal point.

One athlete had a problem with dual groups in prone. Often there would be two very tight groups right next to each other. After careful examination of all factors, and the use of a Noptel training device as an aid for gathering some of the required information, an interesting discovery came to light. The athlete was preloading the trigger – that is holding a significant amount of pressure on the trigger – to the point that it was so close to the release point that the athlete's own heartbeat provided the final amount of trigger pressure to release the shot. The good news is that this provides a very smooth shot release. The bad news is that this is a "fragile" technique that does not hold up under the pressure of competition.

The athlete's inconsistent preload trigger pressure in competition caused some shots to be released on the heartbeat and others between heartbeats. This was enough of a difference to affect the shot grouping. Generally it is found that athletes do not provide enough preload on their trigger. This athlete was the opposite and often had too much pressure. Thinking about the problem dynamically led to the connection, in this case, between trigger preload pressure and heartbeat.

Radar

While exploring aspects of heartbeat, discussed above, and gun movement, discussed below, an experiment was performed to explore the possibilities of using remote sensing to measure heart rate, respiration rate, and body movement of athletes while in actually competition. To do so, there can be no wires or any physical connection whatsoever between the athlete and the measuring equipment.

Several years ago we took a rifle stock (no barrel or action) and a full shooting kit to a lab in the Georgia Tech Research Institute where Dr. Gene Greneker had a number of interesting remote sensing devices and capabilities. One of the most interesting is his "Radar Flashlight" used by law enforcement and rescue crews to "see" through walls, rubble, and other obstacles to find suspects or victims. Another of his devices is an ultra-low power radar, emitting less than a tenth of the amount of energy allowed to leak from microwave ovens at home.

Our goal was to explore the feasibility of remote sensing while an athlete was in actual competition. Arranging a shooter in the prone position, the radar was aimed at the shooter's back. We used prone for this initial exploration to ensure that we could obtain heart and respiration data through the thick shooting clothing. Despite wearing a T-shirt, shooting shirt, sweater, and a stiff (nearly new) Sauer canvas shooting jacket, the radar easily picked up the athlete's heart and respiration movements and body movements. The graph (below) shows a small time slice of raw, unprocessed data when the athlete was very still. One can easily see both pulse and respiration. With processing software, real-time instantaneous and averaged heart and respiration rates, along with body movement (e.g. sway in standing, gun movement, etc.), trigger pressure, and other movements can be observed and calculated.

The exploration proved the viability of the sensing concept and it also provided tangible evidence of the already well understood dynamic nature of the human body, even when seemingly not moving. Time and resources never allowed us to do remote sensing of the athlete with the 160 pulse rate mentioned above. That would have been interesting! With these discussions as background, we now turn to the question of stillness within the dynamic system.

Does The Gun Stop Moving?

A former longtime member of the national team strongly disagreed with a coach's assertion that the rifle or pistol, when on aim, can seem to momentarily stop for the athlete. "The gun never stops moving!" was the strident, public response. From a purely scientific point of view, this athlete is certainly correct. Regardless of how minute, there are movements taking place. However, that is not the point of the coach's assertion.

The important aspect of the assertion is the athlete's perspective, not an external reference. For this particular athlete, indeed the gun may never have stopped moving from his

perspective. Interestingly, for many other well trained athletes and some not so well trained, the rifle or pistol does indeed seem to stop momentarily just when needed.

The most important aspect of this discussion is that the athlete's point of view is the key factor. It has already been conceded that no matter how steady the hold, the gun does have tiny movements when measured from an external reference. We are interested in the athlete's perception here.

Before exploring whether the gun actually stops from the athlete's perspective, and answering the question, we need to explore additional topics. We will begin there in the next article.

The "On The Firing Line" series is published by the national governing bodies for Olympic shooting in Japan and the USA, and has been adapted for archery as "On the Shooting Line" published by USA Archery. Olympic Coach Magazine, the National Association of Soccer Coaches, and others have referenced selected articles. The entire series is available online at www.pilkguns.com.

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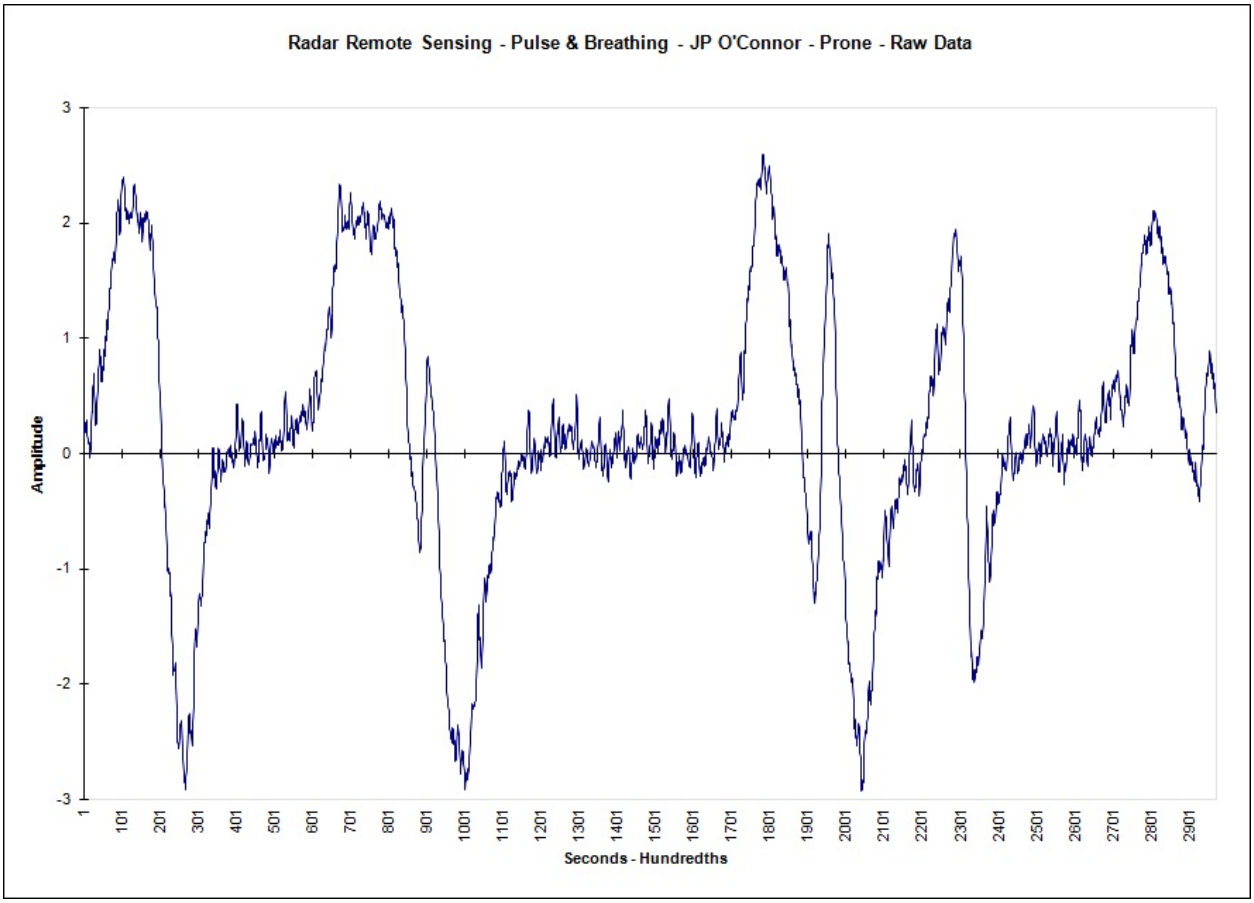
(Biographical information as of August 2014)



Radar Remote Sensing – Even with raw unprocessed data, pulse and respiration are easily discerned.