

TTD Tacking Time to Destination

The Sailing GPS showing optimal tacks and TTD (Tacking Time to Destination). A portable, durable device that can be viewed in direct sunlight.

A new GPS parameter for sailboat navigation...

Sailboat navigation is going through a revolution. Starting a decade ago, you could get email on board with satellite phones or wifi, and check out satellite views of the weather online. No more celestial navigation, sextants, LORAN, radio direction-finders, NavTex weather print-outs, or dead reckoning. If you had problems offshore, you could just phone someone instead of relying on EPIRB.

For more than 20 years, sailors have had convenient access to GPS chartplotters, but are standard GPS chartplotters, and measures like ETA and VMG, now themselves being displaced by innovative new apps and wireless devices?

Dr. Craig Summers was granted a US Patent this year for his 2006 method of calculating optimal tacking routes, which is the core software in the SailTimer app, The Sailing GPS, and chartplotter products from NavSim (Windows) and MacENC (Apple). Given the disruptive innovation that we are seeing with mobile devices as they influence the music industry, movie rentals, the telephone and many other areas of our lives, what are the effects on marine electronics? The following Q&A discussion will attempt to update some common misconceptions about GPS navigation for sailors.



Q. Is the ETA wrong for sailors?

A. Yes; people often think that because GPS satellites can pinpoint your location on the face of the earth, that everything on the screen must be equally accurate. That is not true. Even though Estimated Time of Arrival (ETA) and Velocity Made Good (VMG) are standard GPS parameters, they were designed for powerboats.

Standard GPS units do not account for tacking distances. But if they do not know how far you are going to travel, how can they correctly calculate how long it is going to take? Fortunately, the SailTimer

software solves this problem. It is in products such as The Sailing GPS and the low-cost SailTimer app. It can quickly display the exact distance on each tack, the optimal tacks, and the Tacking Time to Destination.

ETA is wrong for sailboats. Mathematically incorrect. ETA views sailboat tacks as cross-track error. If you are using ETA or VMG on a standard GPS chartplotter, you are not getting accurate, reliable, safe information. And if you are a racer, other boats using custom polar plots, optimal

tacking routes and TTD will have an advantage.

Q. My old GPS from the 1990s has Velocity Made Good (VMG) -- isn't that good enough?

A. The VMG that you are referring to on your GPS is not actually a measure of velocity. That is the first problem with it. You cannot, for example, see that your VMG is 5 knots, and calculate that since you have 10 nautical miles to go, that therefore you will arrive in 2 hours. Wrong: your actual arrival time will be completely

different than this number. Did you know that if you are on the correct tack going upwind with a constant speed, that the VMG commonly displayed on GPSs will decrease all by itself the longer you stay on the tack? It will go all the way down to zero -- and even into negative numbers! What kind of measure of velocity is that? It is like driving down the highway with a constant speed and a constant heading, and having your speedometer decrease all by itself. If car companies sold vehicles that did that, there would be a lot of liability lawsuits. Why should sailors accept any less?

There is a detailed explanation of how this happens with Velocity Made Good (VMG), in the May-June 2009 issue of GAM (available on the Media page of www.TheSailingGPS.com). Or, you can just try it yourself sometime and see it happen on your GPS. Tack to a waypoint upwind, and watch the VMG decrease all by itself, the longer you stay on a tack, even though your speed and heading remain constant.

For sailors, VMG is a terrible measure of velocity, and has no relation to your actual arrival time. That is why it is better to know your optimal tacks, the exact distance

on each tack, and the Tacking Time to Destination (TTD).

Q. When was TTD invented?

A. About eight years ago, during offshore passages on a family sailing trip to the Caribbean, I coined this term to correct for the problems with ETA when sailing. I needed to know when we would make landfall, but ETA would go blank on our chartplotter if we stayed on a tack for very long. Whether you are in a well-equipped cruising boat or just tacking up a little bay in a dinghy sailboat, there are some basic navigation points that all sailors need to know... (1) When are you going to get there? (2) Would it be better to sail upwind more to shorten your distance (but at a lower speed), or better to head off the wind to pick up speed (but with a longer distance)? That dilemma is even trickier when your waypoint is not directly upwind.

My programming team at SailTimer Inc. has been doing R&D on this since 2005 -- a rare example of electronics manufacturing that is still in Canada. TTD eventually became the central parameter in the SailTimer app and The Sailing GPS. Although SailTimer Inc. developed these

products, we view TTD like an industry standard, the same as wifi or Bluetooth, which are also trademarked. The instant display of optimal tacks and TTD is a revolutionary new approach to sailboat navigation.

Q. Why is this better than a full-color chartplotter display?

A. A standard GPS chartplotter on a fully-equipped cruising sailboat may have a beautiful screen, but it is just a map viewer. It does not calculate your optimal tacks or Tacking Time to Destination (TTD), which is what sailors need. 99.9% of the cruising sailboats out there with a GPS chartplotter can only display ETA, and don't account for tacking distances.

The Sailing GPS is not meant to replace a chartplotter, but it can do some innovative things that are useful in any sailboat, whether you have a chartplotter or not. It can show you whether you will arrive faster by heading more upwind to reduce the distance, or by heading off the wind more to increase speed (but with a longer distance). It will display your exact tacking distances, and can even learn your unique boat's polar plots. Plus, it is pretty easy to use.



SailTimer app screenshot from iPad. Version 5 is a major update to the app, with hydrographic charts always in view. Optimal tacks and TTD are displayed as chart overlays. When used with the SailTimer Wind Vane, the tacking results are continuously updated as the wind changes. The flags shown on the chart are from ActiveCaptain social networking, to allow users to share reviews and information about marinas, anchorages and other points of interest. Version 5 is being released free in iTunes. Options such as marine charts and ActiveCaptain are available as low-cost in-app purchases, the same as renting movies or purchasing music in iTunes.



The SailTimer Wind Vane: wireless, solar-powered. Sends wind speed and direction through the air to an iPad, iPhone or The Sailing GPS. From www.SailTimerWindVane.com

You can even just enter the directions of the wind and the waypoint, and from those two buttons alone, it will display the optimal tacking angles.

Q. What if I want to keep things simple when sailing?

A. Unless you are the tactician on a serious racing sailboat, many people don't want to feel like they have information overload, and are spending more time reading instrument gauges than actually sailing or enjoying the water. But what is the one thing that your passengers are going to ask you? "When are we going to get there?" When that question comes up, or when you are trying to make a judgment call about your route, now you have the correct answer when you need it. No matter how much sailing experience you have, it is often difficult to give an accurate estimate of how long your tacking is going to require. Tacking Time to Destination (TTD) gives you the correct answer.

Q. Each boat has a different level of performance - does TTD account for that?

A. Yes. The Sailing GPS can learn the "polar plots" for your unique vessel (i.e., the boat speed in all different wind directions and wind speeds). Then it can calculate your optimal tacking angles and Tacking Time to Destination (TTD). This capability

will be appearing soon in the SailTimer app also. Even if you have polar plots from a manufacturer or from a velocity prediction simulation, that only gives generic results for all boats of a certain type. It is more accurate to learn the custom polar plots for an individual vessel. That accounts for whether you have 6 anchors, a lot of cruising gear on board, and tack with a cup of tea in your hand -- whereas someone else with the same boat has new sails and keeps it empty for racing. So learned polar plots can actually provide different sets of polars for different boats that are the same model. This is actual data too, not just estimates from a simulation.

Q. Don't you have to account for wind angle too?

A. Yes, there are also some short YouTube clips explaining polar plots online at TheSailingGPS.com. It is a pretty big innovation: the only GPS from any manufacturer that learns your vessel's unique polar plots. Since it can learn your individual boat speed in all wind directions and wind speeds, and can calculate the tacking distances, it can then display your optimal tacks and also the correct Tacking Time to Destination.

In order to get real-time data on the wind angle and speed, we have a new product coming out called the SailTimer Wind Vane. This is a wireless, solar-powered

anemometer. The only anemometer in the world that can send wind speed and direction through the air to a handheld device. If you have an iPad running the SailTimer app, or have The Sailing GPS, the optimal tacks and TTD can continuously update as the wind changes, with real-time data coming through the air from The SailTimer Wind Vane (www.SailTimerWindVane.com).

Q. Why not just use your tacking angle to define your laylines?

A. First, the same as polar plots, different boats have different tacking angles. It is not really a good idea to use your tacking angle to define your laylines. If your guesstimate of your tacking angle is off, you will turn onto a layline that is not optimal. Or if you are already on a tack that is not optimal, using a preset tacking angle will automatically make your next tack wrong too. There are easier and more accurate ways to do this, using optimal tacks and TTD. To get your optimal tacks with the SailTimer app or The Sailing GPS, only takes two steps: just enter the directions of the wind and your waypoint, and presto, your optimal tacks are displayed. If you have the SailTimer Wind Vane, you don't even need to enter the wind direction, since it magically arrives through the air in real-time.

In the accompanying photos, you can see on the keypad of The Sailing GPS that the top 3 buttons allow you to quickly generate the optimal tacks. And on the screenshot of the SailTimer app, you can see that the optimal tacks are an overlay on a marine chart, making it very intuitive. The optimal tacks are correct and easy to get. Plus, version 5 of the SailTimer app is going to be released in iTunes as a FREE app, at least at first.

Q. When sailing upwind, why not always just sail at 45 degrees to the wind?

A. While many sailors have rules of thumb, superstitions or approximations based on their sailing experience, in the digital age there are now easier and more accurate methods that are convenient and inexpensive. There are three reasons why this strategy is not the best approach. (1) The SailTimer software is easy to use, and shows your exact tacking distances, optimal tacks and Tacking Time to Destination (TTD). (2) Different boats perform differently; some point higher than others. (3) Even if this rule did work, what are you supposed to do when you are on a tack but your waypoint is not directly upwind? Then sailing 45 degrees on either side of the wind does not work. (4) I know, I only said there were three. But wind speed also affects how high you can point, and whether 45 degrees is optimal or not. The optimal tacks and TTD in SailTimer software are easy to use, accurate, and work in all wind directions and all wind speeds.

Q. Can you use The Sailing GPS or SailTimer app by itself, or do you also need the wind vane?

A. You can enter the wind direction and speed manually, or it can receive real-time wind data via Bluetooth. Before you set out, if you are wondering where the winds will take you today, you can enter the forecasted wind direction manually. You don't need to be underway to do this, like you do with telltales, tacking angles or VMG. If you want the optimal tacks and TTD to continuously update as the wind changes, then you have the option of adding the SailTimer Wind Vane.

Q. What innovations are built into the SailTimer Wind Vane?

A. The SailTimer Wind Vane is wireless and solar-powered. No wires to run down the mast or through the boat. Just attach it to the masthead with 2 screws. It also

comes with a U-bolt for quick mounting on a stanchion, and can be mounted at home if you want to monitor winter storms in the off-season. The advanced lithium batteries are unaffected by sub-zero temperatures.

Although it is easy to install, don't let that fool you. The SailTimer Wind Vane has some amazing engineering in it. It spends most of its time in a deep sleep, but wakes itself up every 8 seconds to see if anything wants to talk to it. Then it sends quick messages to save power that last only a few milliseconds, before going back to sleep temporarily. We developed a very advanced power system, which took months of R&D. It can last 65 days on a single battery charge. It can recharge 8 hours of sailing in 1 hour of direct sunlight. It is totally self-sustaining, because it is solar powered and wireless. It has a lifespan of 20 years, before the advanced lithium batteries would need to be replaced. You can basically just set it outside, and come back in the year 2032, and it will still be waking up and checking if anyone wants to talk to it.

Q. What are the advantages of a single-purpose device like The Sailing GPS when I can have movies, web browsing and everything on a smartphone or tablet?

A. Sometimes an app is convenient. It is low-cost, and displays amazing graphics on the mobile device you already have in your pocket. But maybe you don't want to take your beautiful iPad out on a Hobie Cat or dinghy sailboat where it is wet and where things are flying around. Or maybe you row a dinghy out to your sailboat on a mooring, and protecting your iPad to even get it on the boat is not so easy. In that case, The Sailing GPS may be more suitable, because it is durable, comes in a waterproof bag, and can be easily viewed in direct sunlight.


Q. Does it take the fun out of sailing if you know the optimal tacks and TTD?

A. No, The Sailing GPS and the SailTimer app for iPad/iPhone don't replace your decision-making or take the fun out of sailing. They are just better measures for sailors than the ETA and VMG that have been standard for the last 20 years, since consumer GPS arrived. You don't want to replace your judgment and seamanship, but you want to use your judgment based on correct information.

Q. What should we expect for future sailboat navigation capabilities?

A. Within the first ten days after The Sailing GPS began shipping this year, word had spread through dozens of online blogs and forums about this paradigm shift in sailboat navigation. Different people have different preferences about how they like to sail. Some are cruisers and some are racers. But there has been no fundamental disagreement about the problems that ETA and VMG pose for sailors. These were not designed for the tacks that sailboats do. They are mathematically incorrect for sailing. ETA and VMG could even pose a safety hazard when sailors are unaware that the results they display are not reliable.

A new consensus seems to have emerged that is not just for the million-dollar navigation systems and tacticians on America's Cup racing boats, but is now for any consumer who wants to see laylines on a mobile device while sailing.

Rather than ETA and VMG, for correct information, sailors should use Tacking Time to Destination. 

Reprinted with permission of GAM on Yachting Magazine; May 2012