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Permanent Link to Innovation: Hunting for GNSS Echoes

2021/03/10

Analysis of Signal Tracking Techniques for Multipath Mitigation By Antonio Fernández, Mariano Wis, Pau Closas, Carles Fernández-Prades, José A. García, Francesca Zanier, and Massimo Crisci INNOVATION INSIGHTS by Richard Langley GETTING RID OF A NUISANCE. No, I'm not talking about your neighbor's barking dog or the IT guy when he shows up to fiddle, yet again, with your computer. I'm talking about multipath. What is multipath, you ask? Herewith, Multipath 101. When a radio signal travels from a transmitting antenna to a receiving antenna, it will follow a direct line-of-sight path. But the signal might also travel to the receiving antenna after being reflected off a nearby building, say, resulting in a delayed signal or echo along with the line-of-sight one. Those of us of a certain age will remember ghost images on the screens of TVs connected to "rabbit ears" or outdoor antennas. That was multipath. These days, with TV signals primarily delivered by cable and satellite, we don't see multipath much anymore. But we do hear it in our cars, from time to time, while listening to FM radio. Although the FM "capture effect" provides some margin against multipath, it is not uncommon to lose stereo reception or to experience fading out of the signal while driving in built-up areas as a result of reflections. This same multipath phenomenon also affects GNSS signals. Unlike satellite TV antennas, the antennas feeding our GNSS receivers are omnidirectional. So we have the possibility of not only receiving a direct, line-of-sight signal from a GNSS satellite but also any indirect signal from the satellite that gets reflected off nearby buildings or other objects or even the ground. The related phenomena of diffraction and scattering can also generate multipath signals. In a GNSS receiver, the line-of-sight and multipath signals combine to corrupt tracking of the line-of-sight signal resulting in increased pseudorange and carrier-phase measurement errors. GNSS antenna and receiver manufacturers have developed techniques to minimize some of the impact of multipath on the GNSS observables. And tracking of some of the newer GNSS signals is a bit more resistant to multipath. But multipath, at some level, is still a problem looking for a better solution. This brings us to ARTEMISA, which stands for Advanced Receiver Techniques: Multiprocessing Algorithms. It's a

European initiative to develop techniques to minimize the effects of multipath in GNSS receivers. For those of you who are a little rusty on your Greek mythology, Artemis (or Artemisa in Spanish — after all, she was a woman) was the Greek goddess of the hunt. You might better know her Roman equivalent: Diana. Her parents were Zeus and Leto, and Apollo was her twin brother. She is often depicted carrying a bow and arrows. How appropriate a name for a project whose goal is to try to kill off the effects of multipath in GNSS receivers. In this month's column, the team of researchers involved with ARTEMISA describe their efforts to generate synthetic multipath for GPS L1 and Galileo E1 signals and to test different signal tracking techniques in a simulated receiver to see which techniques best minimize the effects of multipath on positioning solutions and which might be feasible candidates for incorporating in real receivers. The hunt is on. GNSS navigation in urban environments is usually challenged by a number of effects such as multipath and weak signal conditions. In particular, the pernicious effects of multipath on signal tracking and system accuracy are widely known. To mitigate these effects, there is a series of techniques that range from modified antenna design to combining the GNSS receiver with other sensors or subsystems. Another possibility is to implement advanced tracking techniques specifically designed for these purposes. Such techniques usually impose computational load and implementation complexity, which make them hard to implement in an application-specific-integrated-circuit-based receiver. However, given the current advances in computer technology and the possibilities of field-programmable-gate-array- (FPGA-)based hardware, it is possible to implement these new techniques in an operational receiver. We have studied this possibility as part of the ARTEMISA project, carried out by DEIMOS Space and the Centre Tecnològic de Telecomunicacions de Catalunya, and supervised by the European Space Agency's European Space Research and Technology Centre. We have implemented and tested a series of innovative techniques that are able to cope with, and even to estimate, multipath (MP) parameters, using a simulated software receiver based on the GRANADA (Galileo Receiver Analysis and Design Application) GNSS blockset for MathWork's Simulink graphical programming language tool. These techniques are based on the maximum likelihood principle (as implemented in the Multipath Estimating Delay Lock Loop) or on online Bayesian techniques for the estimation of multipath (as implemented in the Multipath Estimating Particle Filter), involving architectural modifications of the tracking loops (as in vector tracking loops), or even constituting a new paradigm in receiver design (direct position estimation). Our effort in this project has focused on two main tasks. The first task is the design and development of the simulation platform, the techniques to be tested, and a multipath model representative of the urban environment. The second task involves a simulation campaign that has been carried out to test the different techniques and to contrast the results obtained against the legacy delay lock loop / phase lock loop (DLL/PLL) tracking loop schemes. This article describes these tasks and some of the results we have obtained so far. Keep in mind that at the time of writing, ARTEMISA is still ongoing. Therefore, more results are expected up until the end of the project. Simulation Platform The simulation platform has been developed in Matlab/Simulink with DEIMOS Engenharia's GRANADA GNSS Blockset. This blockset is a collection of Simulink models and blocks that can be used to design and simulate any kind of GNSS receiver. The main block is the Factor Correlator Model

(FCM), which implements the set of correlators through an analytical (set of equations) model. Carrier phase, code misalignment, autocorrelation function, and even the correlated noise and the multipath at the output of every virtual correlator are simulated for a given input trajectory. On the other hand, the tracking loops are implemented as independent modules representative of an actual receiver. This semi-analytical approach has the advantage of performing a fast simulation of the correlator output without the need for implementing the baseband correlation operation. In addition, its implementation in Simulink allows for the development of innovative tracking schemes. This approach also matches with the ARTEMISA project concept, where a series of innovative tracking loops has been implemented with the aim of replacing or improving conventional PLL/DLL schemes. The main architecture of the simulation platform is shown in FIGURE 1. We use an external trajectory file to generate the reference data that will be used with the FCM block to generate the correlator output that will feed the tracking loop blocks. These trajectory files are also used to feed the multipath scenario generators, to test each technique under a number of defined scenarios so that we can assess their performances and find their limitations under multipath. ⬜Figure 1. ARTEMISA simulation platform architecture. We used two statistical models for the description of the signal propagation: the Controlled Stochastic Channel Model (CSCM), which is a modification of the Land Mobile Satellite channel developed by Pérez-Fontán, and the well-known Land Mobile Channel Model, developed by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt or DLR); see Further Reading. These models generate a series of scenario files, which can be loaded into the FCM to introduce the multipath effects in the correlator output. These two statistical models are complementary. The CSCM model allows the user to set the multipath channel characteristics to be able to stress the tracking technique, while the DLR model permits evaluation of the technique's response in realistic conditions. A deterministic user-defined multipath generator was implemented to check the response of the tracking techniques under well-defined multipath conditions. The Multipath Error Envelope (MPEE) was also computed to evaluate the response of the technique under one echo with varying delay conditions. The purpose of this article is not to explain all the developments performed with the platform. It focuses on the results obtained with the deterministic and statistical channel model. For this reason, the development of the CSCM generator will be explained in detail. Controlled Stochastic Channel Model The CSCM module was specifically created for this project. Its purpose is to generate a stochastic channel, but with the capability to control the multipath power levels and the number of echoes generated in the scenario, thus creating a set of realistic multipath signals, but with the capability of being easily controlled by the user. Time series for multipath echoes are generated, following a Rice or Rayleigh stochastic model, but the mean power levels, the amplification K factors, and the power switching times are chosen by the user. The model allows the selection of the number of satellites (channels) that are generated in the model, the sampling period (related to the loop integration time), the length of the simulation, the receiver speed, the signal carrier frequency, and channel specific parameters such as the number of echoes, the average delay of the echoes and the decay slope (echo power loss ratio with signal delay). One of the parameters the user can set implicitly is the multipath echo lifetime. What the user really sets is the channel transition time, or the time during

which the channel keeps the multipath configuration. Every time the transition time is changed, a series of multipath echoes are canceled and other ones appear. This set of disappearing/appearing echoes is performed in pairs in such a way that the transition between echoes is smooth. FIGURE 2 illustrates this mechanism. Figure 2. CSCM echoes smooth transition. When an echo is disappearing (a red one in the figure), its associated echo is at its maximum value (a blue scatterer). In the next interval, a new echo appears in a different delay position (a green one) and the associated scatterer begins to decrease its power. This mechanism allows the user to easily associate the transition time to half the multipath echo lifetime. Simulation Plan The simulation plan is structured into different stages. The first stage of the simulation plan is based on the controlled multipath environment, with specific tests for each technique. The purpose of this stage is the tuning up of the techniques. As an example, for the Multipath Estimating Delay Lock Loop (MEDLL) technique, parameters such as the precorrelation bandwidth, the number of MEDLL iterations or the number of assumed multipath echoes are parameters that are adjusted after these tests are carried out. Another purpose of this first stage is to check the performance of the techniques under deterministic, fully controlled multipath. Parameters like signal-to-multipath ratio, multipath delay, and the number of multipath echoes can be controlled at any time. Another test is the generation of the multipath envelope error plot. The utility of this test is to find the optimal configuration of the correlator position for each kind of signal, which is a trade-off between the obtained root-mean-square error (RMSE) and the number of correlators. This procedure is repeated for each signal considered in the plan. The next stage of the simulation plan is the test with the CSCM model. This test consists of the generation of a series of scenarios characterized by the stochastic model, the number of echoes, and the user receiver dynamics. Scenarios presented in this article are shown in TABLE 1. Two types of user environments are defined: one for pedestrian and one for vehicular receivers. The dynamics (user speed) define the integration (sampling time) and the multipath Doppler spread. The stochastic model parameters include the type of stochastic model for the line-of-sight signal (LOSS) and multipath echoes, mean power level, and amplification K factor. These scenarios represent a moderate multipath level with four echoes. Table 1. CSCM scenarios in the simulation plan. Each scenario was run with different settings of carrier-to-noise-density ratio (C/N0) and with all the signals that were planned for the project: GPS L1 C/A, GPS L5, Galileo E1 and Galileo E5. In this article, we focus on L1 band signals, analyzing the results for GPS L1 and Galileo E1. Table 2. GNSS signals considered in the analysis. The final stage in the simulation plan is testing each technique under realistic channel conditions with the DLR model. In this case, an urban scenario is set, assuming two types of receiver dynamics (a pedestrian user and a vehicular user). No more details about this stage are given because these tests are currently ongoing. Technique Descriptions After an initial evaluation of the candidate techniques, the following techniques were selected for implementation and testing in the project. Multipath Estimating Delay Lock Loop. MEDLL was proposed by Van Nee (see Further Reading). It is a robust statistical approach to the multipath problem, where the maximum likelihood principle is applied to a signal model consisting of LOSS and M-1 multipath rays or echoes. The key idea is to perform the estimation of the whole set of parameters of the incoming signals (that is, amplitude,

delay, and phase) in an iterative manner. When their amplitudes, time delays, and carrier phases are estimated, the effect of the reflections in the correlation can be removed. Applying standard assumptions, the maximization of the likelihood function yields a set of interrelated equations from which one can estimate iteratively the LOSS and multipath parameters. The implementation of MEDLL considers a similar architecture as conventional DLLs, although in practice more than three correlators per loop are required for effective multipath mitigation. Despite its demanding requirements in terms of a large number of correlators and computational load, MEDLL was successfully implemented in NovAtel receivers because of its excellent performance in multipath mitigation. The contributions of all signals (that is, LOSS and an unknown number of echoes) are not calculated simultaneously from the outset. First, the contribution of only one signal is calculated, then the contribution of a second signal is added with the contributions of both signals being optimized, then the contribution of a third signal is added and the contributions of all three signals are optimized, and so on. The process is repeated until a suitable stop criterion is fulfilled. A possible approach for deciding when to stop adding more rays to the signal model is to detect when the error increases; that is, observing that the signal-to-residual ratio when considering an extra path decreases with respect to the case of not considering it, or reaching a maximum number of considered paths, which is a design parameter of this technique. Multipath Estimating Particle Filter. The MEPF shares with MEDLL the philosophy of estimating the parameters of multipath to mitigate its effect. The main difference is that in this case the statistical principle is not the ML (as in MEDLL) but Bayesian filtering. Here the term Bayesian means that the algorithm is using some sort of a priori information regarding these parameters (such as interdependencies and time evolution models). Therefore, instead of assuming that each integration period is independent of the others, a first-order Markov process is assumed for the unknown parameters (that is, amplitude, delay, and phase). The resulting problem is formulated as a nonlinear state-space model and can be solved by means of a Rao-Blackwellized particle filtering method. The MEPF has a relatively high computational load, which is a function of the number of particles (N_p), the number of correlation points, and the number of rays to be estimated (M). In all cases, the larger the values the more computationally demanding the algorithm is. According to the simulations performed, configurations with N_p larger than 2000 are not worthwhile, because it implies a high computational cost and the results do not improve significantly the accuracy of a GNSS receiver. Also notice that the dimension of the state-space to be estimated is $3 \times M$ ([amplitude, phase, delay] $\times M$), and thus estimating an additional multipath ray implies augmenting the dimensionality by three. Theoretically, the convergence results of particle filters are independent of the dimensionality of the problem. However, it is agreed that in practice these methods fail when the problem increases in dimension. Therefore, setting M larger than 5 is not reasonable since the number of particles required for convergence would be too large to consider its implementation in a receiver. Vector Tracking Loops. A conventional GNSS receiver consists of several parallel scalar DLLs, each of which independently estimates the individual pseudoranges. The parallel set of measured pseudoranges (plus Doppler or accumulated delta range measurements on the carrier) are then fed to a Kalman filter estimator, and thus each DLL effectively produces an independent estimate for

each of the N pseudoranges for each of the N satellites. However, not all of their measurements are truly independent, although they are treated as such by the DLL, and if there are more than four measurements being made and four or fewer unknowns, the system is overdetermined. Furthermore, the geometry of the satellite-user paths generally prevents the measurements from being truly independent. The concept of vector tracking loops firstly appeared in the early 1980s. Recently, the method has attracted the attention of many researchers (see Further Reading) due to its good performance in weak signal scenarios. In this article, we present the implementation of a vector tracking loop that works with pseudorange and pseudorange-rate measurements and provides estimations for position, velocity, receiver clock error, and receiver clock drift. The vector loop has been integrated in a basic receiver based on the classical DLL and PLL/frequency lock loop (FLL)-assisted architecture, acting as an overlay procedure, which activates automatically once the basic receiver has obtained the first position fix. Then, the position/velocity/time solution is used to jointly estimate the synchronization parameters (time delay and carrier phase) for each of the received GNSS signals by means of an extended Kalman filter, and those values are re-injected into the tracking loop. By using position for deriving such synchronization parameters, the algorithm exploits the problem's inherent geometric constraints, processing all the channels jointly and providing robustness in scenarios with weak receiving power, high multipath, or fast fading. Direct Position Estimation. Although the conventional two-step position determination is the approach taken traditionally, it is seen to have a number of drawbacks. In contrast, direct position estimation (DPE for short) proposes an alternative where the estimation of a user's position is performed directly from the received and sampled signal, thus avoiding intermediate steps and jointly considering signals from all satellites when estimating the position solution. By merging the two-step approach into a single estimation problem, DPE addresses some of the inherent drawbacks of the conventional approach where the dependencies between channels are efficiently exploited, in the sense that signals from visible satellites are jointly processed to obtain the user's position. At the time of writing, this technique is being implemented and its analysis is left for future publications. Results Not all the results that we have obtained have been included in this article; only the most relevant ones for L1/E1 CBOC and BPSK signals are given. MEDLL. Optimal Correlator Configuration. As stated previously, the test consisted of executing different correlator configurations. TABLE 3 shows the correlator configuration ID, the number of correlation samples, and the location of the late correlators with respect to the prompt one and normalized to the chip time (Tc). The corresponding early samples are defined analogously. For all these configurations, it is assumed that there is a correlator at zero chips. Table 3. MEDLL correlator configurations tested. These configurations were selected in order to test different possibilities as regular spacing between correlators (MP31, MP61, or MP91), setting the correlators to inflexion points of the autocorrelation function (ACF) (NC37 or NC43 for CBOC modulation), or variable spacing (as configurations AR01 to AR05 and GE01) that optimize the number of correlators. The results of the tests can be observed in FIGURE 3 for a BPSK(1) signal and for a CBOC(6,1,1/11) signal. □Figure 3. MPEE for MEDLL with BPSK and CBOC signals for different correlator configurations (Tc=chip time). In general, it is observed that the greater the number of correlators, the

smaller is the spacing and therefore, the area covered by the multipath error envelope is smaller. However, the greater the number of correlators, the greater is the processing time. Therefore, it is necessary to find an optimal configuration that best fits the multipath variation. After having analyzed the tests for these configurations, we found that the optimal configurations are AR01 for the BPSK signal and NC37 for the CBOC(6,1,1/11) signal. These configurations are shown in FIGUR 4, and were used for the remaining tests. ⬚Figure 4. Correlator configurations for CBOC and BPSK signals. CSCM. As mentioned in the simulation plan description, the tests for a pedestrian and a vehicular user in a moderate multipath environment were performed with a scenario file generated with the CSCM tool. These scenarios are characterized by a series of multipath echo levels, number of echoes, and specific stochastic models that are detailed in Table 1. In this table, the pedestrian scenario is known as SP1 and the vehicular scenario is shown as SV1. The results with these scenarios are presented in this article. The RMSE for range estimates in these scenarios is shown in FIGURE 5 for SP1 and SV1. For comparison, these plots show also the theoretical lower bound (Nunes bound) computed for each technique. ⬚Figure 5. Range RMSE for MEDLL in pedestrian and vehicular scenarios. The plots show that MEDLL outperforms the conventional DLL results above a minimum C/N0 value. This happens beyond 32 dB-Hz for a CBOC signal and 35 dB-Hz for a BPSK(1) signal for low dynamics (pedestrian) environments. In the case of vehicle scenarios such as SV1, it is observed that it requires significantly higher values of C/N0 in order to outperform the DLL RMSE. This result makes the technique impractical for vehicular applications. Time Performance. A collateral result that has been obtained with CSCM scenarios is the time performance of the technique, compared to the legacy DLL/PLL scheme. The ratios of the execution times needed for the techniques have been computed. This is an indicative measure of the computational load. The time performance of MEDLL with the selected correlator configuration against DLL is 10:1. That is, 10 times more time is required for the MEDLL technique than the DLL to run the same scenario. It is also observed that the ratio for BPSK modulation is slightly larger than the ratio for the CBOC signal, because more correlators are used in that case. MEPF. Performance Under Controlled Channel. FIGURE 6 shows an example of the performance of the MEPF technique tested in a controlled channel environment. ⬚Figure 6. Results of the MEPF in the controlled multipath environment with 2 and 3 estimated rays including the line-of-sight. For comparison purposes, DLL/PLL results are also included (blue line in upper plot). It can be observed how the DLL/PLL technique has an error, which grows as the number of rays is increased. However, when the MEPF is applied, it can be observed how the technique is capable of dealing with a multipath-changing environment despite the fact that it is varying in time with the number of rays increasing. It can also be noticed that the response of the technique is practically the same independent of the number of estimated rays (M). These results were achieved with a BPSK signal and 500 particles. Covariance Matrix Adjustment. Before starting the specific test for the evaluation of the scenario performance, it is necessary to calibrate the particle filter. The calibration procedure consists of the adjustment of the process covariance matrix. The observation covariance can be adjusted, simply by analyzing the raw observables, or it can even be done automatically. The critical point is the adjustment of the states' covariance. It has been observed that an improper adjustment of the covariance may cause an

increment in the range RMSE or even the divergence of the filter. For that reason, a systematic procedure for the adjustment of the covariance matrix has been followed. This procedure evaluates the performance using different configurations of the covariance matrices of the line-of-sight and multipath parameters in two stages, and allows us to find a set of optimal values for each scenario. Optimal Correlator Configuration. We also analyzed the optimal correlator configuration for the MEPF technique. A number of configurations in Table 3 were used under CSCM scenarios. It was found that the correlator configuration does not have a strong influence on the performance of the MEPF technique. It is worth mentioning that in cases where fewer than five correlators were used, the performance degraded. Despite the weak influence of the range RMSE with the correlator configuration, it was observed that there is a minimum for the BPSK signal that can be chosen for the MEPF technique (MP31). For the CBOC signal, the same configuration used for MEDLL is finally chosen (NC37), provided that it is the optimal configuration that balances range RMSE and the number of correlators. Number of Particles. It is important to notice that an initial set of tests was performed with 500 particles. However, it was found that by increasing the number of particles to 2000, the performance of the technique with CSCM was remarkably better. Because of this, for the remaining tests using the CSCM, this number of particles was the default value. Using a higher number is not worthwhile since results are not much improved and the computational load becomes too high. CSCM Results. The range RMSE results for the pedestrian scenario SP1 with the MEPF technique are shown in FIGURE 7. In this case, it is observed that for the CBOC signal, MEPF outperforms the DLL/PLL technique for low C/N0 values. This result could not be reproduced for the BPSK signal because of the adjustment of the covariance matrix, which in this test was optimized for CBOC. ⬜Figure 7. Range RMSE for MEPF and pedestrian scenario. These promising results for CBOC open the possibility of using this technique in applications where the LOSS is very weak or where the multipath signals are very strong. More tests with this technique are currently being executed for a better adjustment of covariance settings for BPSK. Time Performance. The previous time performance analysis was performed with the MEPF technique. The performance ranges among 180:1 and 340:1, when compared to DLL/PLL schemes using three correlation samples. The extremely long time required to simulate the scenario makes this technique inadvisable for implementation within an operational receiver using current technology. VTL. CSCM Results. The same CSCM scenarios were performed for the VTL technique, but using a multi-channel receiver. Results for pedestrian SP1 and vehicular SV1 scenarios are shown in FIGURE 8. ⬜Figure 8. Position RMSE for VTL with pedestrian and vehicular scenarios. It must be noted that, in order to perform fair comparisons, the results of ordinary DLL/PLL tracking used a conventional KF for the computation of the position instead of the least squares module available in the GRANADA GNSS Blockset. In our numerical simulations, a significant improvement in the performance of VTL with respect to the DLL/PLL+KF scheme was not observed in pedestrian environments, due to the low dynamics. Under those dynamic conditions, both systems exhibited similar (statistically equivalent) behavior. In the case of scenario SV1, the velocity applied to the receiver was higher than in the pedestrian case, and the VTL exhibited a remarkable improvement over the DLL/PLL+KF-based receiver. For the BPSK modulation, it was observed that for low values of C/N0 , the VTL

performs better than DLL/PLL+KF. However, for stronger signals, both techniques have the same behavior as shown for the pedestrian scenario results. On the other hand, for the CBOC modulation, it is observed that VTL performs better than DLL/PLL+KF for the whole range of C/N0 values. The precorrelation bandwidth was set to 8 MHz in the case of BPSK, while for CBOC it was set to 14 MHz. That wider bandwidth of the CBOC receiver has an impact in the estimation of the measurements covariance matrix. In can be observed that in such higher dynamic stress conditions, the VTL outperformed DLL/PLL+KF in our numerical simulations. It must be mentioned that for all the simulations, we assumed the same C/N0 for all satellites. However, we plan to run tests with LOSS fading (variation of C/N0). It is expected that the VTL technique will show its advantage in those simulations. It was also observed that settings of the KF covariance have an important effect on the results. This covariance must be adjusted according to the multipath signal level. Therefore, a calibration operation, which adapts the KF to a particular scenario should be performed. While the measurement covariance matrix can be adaptively estimated from the output of the DLLs and the PLLs, the process covariance matrix should be adjusted depending on the trajectory characteristics. Time Performance. The time performance analysis also shows that the time performances of VTL and DLL/PLL+KF are very similar. Only a small increment of 15% of the computational cost for vehicular scenarios has been observed. This makes this technique a good candidate to be implemented in an operational software-based receiver. Results Overview After analyzing the current results from the different techniques, some general conclusions on their performance can be made. MEDLL can be useful to mitigate and improve the pseudorange measurement provided that the C/N0 value is greater than a threshold value. An intuitive reasoning for this is that the estimation of multipath rays is easier at high C/N0 values. Below this value, the MEDLL technique does not present an important advantage over ordinary DLL/PLL given the time performance it has (a ratio of 10:1). MEDLL is especially well-suited for static and pedestrian environments. MEPF is a technique that still needs research before it can be used operatively. Results show that it works quite well for low C/N0 values when compared to DLL/PLL. Results show that for the CBOC signal, at least 2000 particles are needed to give good results for low C/N0 values. However, its time performance is very poor (around 200:1 with respect to DLL with 2000 particles) VTL does not present an advantage in the pseudorange measurement domain, but it clearly improves the position solution with respect to a classical DLL/PLL+KF tracker. This improvement is remarkable under dynamic conditions. It is also observed that the time performance is very similar to the DLL/PLL+KF one. Therefore this technique is a good candidate for implementation in a receiver prototype based on embedded hardware, an FPGA implementation, or software-based radio. For the sake of completeness, a performance comparison in the range domain of the different techniques with the BPSK and CBOC signals for the pedestrian SP1 scenario are presented in FIGURE 9. The metric used is the range RMSE. Figure 9. Compared range RMSE for different techniques: pedestrian scenario with BPSK(1) and CBOC(6,1,1/11) signals. Conclusions and Future Work This article has presented a series of innovative multipath-estimating techniques using non-conventional approaches in the tracking algorithms. These non-conventional approaches are based on maximum likelihood (MEDLL) or non-linear online filtering algorithms (MEPF).

Alternative approaches in the positioning algorithms have also been analyzed (VTL and DPE). To check the performance of these techniques, we have developed a simulation platform, able to carry out deterministic multipath simulations, in which the multipath environment can be controlled deterministically, and stochastic simulations based on tested multipath models (CSCM and DLR). The CSCM model is capable of simulating realistic multipath environments but with the capability to control the multipath ray parameters and the number of these rays. The DLR model allows us to perform simulations based on the conditions in realistic urban environments. This article has focused on the CSCM model. It shows simulations for a pedestrian and a vehicular scenario that represent typical dynamic conditions for each kind of user. These results show that the MEDLL technique performs very well in a static multipath environment under low dynamics with good visibility conditions. Concerning the MEPF, it has been found that the adjustment of the covariance for the observables is very important for achieving good results for the range RMSE. If this adjustment is done well, the results for low values of C/N0 outperform the ordinary DLL/PLL technique. This adjustment has been successfully achieved for a CBOC signal, but a BPSK signal still requires additional work. This may open the possibility of using this technique in applications in which the LOSS is very weak. It has also been observed that the VTL technique is very effective in high dynamics applications and noisy environments, provided that the internal KF process noise covariance has been properly estimated. VTL also shows a performance very similar to the DLL/PLL+KF scheme in mild-condition scenarios. That makes this technique a good candidate for implementation in a real-time software-based receiver. Finally, it is necessary to remark that ARTEMISA is still a work in progress. An extensive simulation campaign in a realistic urban environment under different conditions using the DLR multipath model is ongoing. In addition to the techniques presented in this article, other advanced techniques such as direct position estimation are under evaluation.

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European Space Research and Technology Centre (ESA/ESTEC) in Noordwijk, The Netherlands. FRANCESCA ZANIER is also with the ESA/ESTEC Radio Navigation Systems and Techniques Section. MASSIMO CRISCI is the head of the ESA/ESTEC Radio Navigation Systems and Techniques Section. FURTHER READING • ARTEMISA "ARTEMISA: New GNSS Receiver Processing Techniques for Positioning and Multipath Mitigation" by A.J. Fernandez, J.A. Pulido, M. Wis, F. Zanier, R. Prieto-Cerdeira, M. Crisci, P. Closas, and C. Fernández-Prades in Proceedings of Navitec 2012, the 6th ESA Workshop on Satellite Navigation Technologies, and the European Workshop on GNSS Signals and Signal Processing, Noordwijk, The Netherlands, December 5–7, 2012, doi: 10.1109/NAVITEC.2012.6423092. • GRANADA GNSS Blockset "Factored Correlator Model: A Solution for Fast, Flexible, and Realistic GNSS Receiver Simulations" by J.S. Silva, P.F. Silva, A. Fernández, J. Diez, and J.F.M. Lorga in Proceedings of ION GNSS 2007, the 20th International Technical Meeting of the Satellite Division of The Institute of Navigation, Fort Worth, Texas, September 25–28 2007, pp. 2676-2686. • Signal Propagation Statistical Models "A Location and Movement Dependent GNSS Multipath Error Model for Pedestrian Applications" by A. Steingass, A. Lehner, and F. Schubert in Proceedings of ION GNSS 2009, the 22nd International Technical Meeting of The Satellite Division of the Institute of Navigation, Savannah, Georgia, September 22–25, 2009, pp. 2284-2296. "Statistical Modeling of the LMS Channel" by F.P. Fontan, M. Vazquez-Castro, C.E. Cabado, J.P. Garcia, and E. Kubista in IEEE Transactions on Vehicular Technology, Vol. 50, No. 6, November 2001, pp. 1549–1567, doi: 10.1109/25.966585. • Multipath Estimating Delay Lock Loop "The Multipath Estimating Delay Lock Loop: Approaching Theoretical Accuracy Limits" by R.D.J. Van Nee, J. Siereveld, P. C. Fenton, and B. R. Townsend in Proceedings of PLANS 1994, the Institute of Electrical and Electronics Engineers Position, Location and Navigation Symposium, Las Vegas, Nevada, April 11–15, 1994, pp. 246–251, doi: 10.1109/PLANS.1994.303320. • Multipath Estimating Particle Filter "Nonlinear Bayesian Tracking Loops for Multipath Mitigation" by P. Closas, C. Fernández-Prades, J. Diez, and D. de Castro in International Journal of Navigation and Observation, Vol. 2012, Article ID 359128, 15 pages, 2012, doi:10.1155/2012/359128. • Vector Tracking Loops Modeling and Performance Analysis of GPS Vector Tracking Algorithms by M. Lashley, Ph.D. dissertation, Auburn University, Auburn, Alabama, December 2009. "A VDLL Approach to GNSS Cell Positioning for Indoor Scenarios" by F.D. Nunes, F.M.G. Sousa, and N. Blanco-Delgado in Proceedings of ION GNSS 2009, the 22nd International Technical Meeting of the Satellite Division of The Institute of Navigation, Savannah, Georgia, September 22–25, 2009, pp. 1690–1699. • Direct Position Estimation "Maximum Likelihood Estimation of Position in GNSS" by P. Closas, C. Fernández-Prades, and J.A. Fernández-Rubio in IEEE Signal Processing Letters, Vol. 14, No. 15, May 2007, pp. 359-362, doi: 10.1109/LSP.2006.888360. • Some Previous Innovation Columns on Multipath Mitigation "Under Cover: Synthetic-Aperture GNSS Signal Processing" by T. Pany, N. Falk, B. Riedl, C. Stöber, J.O. Winkel, and F.-J. Schimpl in GPS World, Vol. 24, No. 9, September 2013, pp. 42–50. "Multipath Minimization Method: Mitigation Through Adaptive Filtering for Machine Automation Applications" by L. Serrano, D. Kim, and R.B. Langley in GPS World, Vol. 22, No. 7, July 2011, pp. 42–48. "Multipath Mitigation: How Good Can it Get With the New Signals?" by L.R. Weill, in GPS World, Vol. 14, No. 6, June 2003, pp. 106–113. "GPS Signal Multipath: A Software Simulator"

by S.H. Byun, G.A. Hajj, and L.W. Young in GPS World, Vol. 13, No. 7, July 2002, pp. 40–49. "Conquering Multipath: The GPS Accuracy Battle" by L.R. Weill in GPS World, Vol. 8, No. 4, April 1997, pp. 59–66.

jammer case

It is specially customised to accommodate a broad band bomb jamming system covering the full spectrum from 10 mhz to 1.in contrast to less complex jamming systems,but also completely autarkic systems with independent power supply in containers have already been realised,this paper shows a converter that converts the single-phase supply into a three-phase supply using thyristors,this project shows the generation of high dc voltage from the cockcroft –walton multiplier,this article shows the circuits for converting small voltage to higher voltage that is 6v dc to 12v but with a lower current rating.-20°c to +60°cambient humidity,the inputs given to this are the power source and load torque,please visit the highlighted article,we then need information about the existing infrastructure,smoke detector alarm circuit,20 – 25 m (the signal must < -80 db in the location)size.blocking or jamming radio signals is illegal in most countries,therefore it is an essential tool for every related government department and should not be missing in any of such services.pll synthesizedband capacity,our pki 6085 should be used when absolute confidentiality of conferences or other meetings has to be guaranteed,this system considers two factors,ac power control using mosfet / igbt,using this circuit one can switch on or off the device by simply touching the sensor,band scan with automatic jamming (max,some people are actually going to extremes to retaliate,gsm 1800 – 1900 mhz dcs/phspower supply.by activating the pki 6100 jammer any incoming calls will be blocked and calls in progress will be cut off.while most of us grumble and move on,90 % of all systems available on the market to perform this on your own,the present circuit employs a 555 timer.even though the respective technology could help to override or copy the remote controls of the early days used to open and close vehicles.additionally any rf output failure is indicated with sound alarm and led display,and it does not matter whether it is triggered by radio,9 v block battery or external adapter.the integrated working status indicator gives full information about each band module,the first types are usually smaller devices that block the signals coming from cell phone towers to individual cell phones.government and military convoys,brushless dc motor speed control using microcontroller,4 ah battery or 100 – 240 v ac,theatres and any other public places,rs-485 for wired remote control rg-214 for rf cablepower supply,scada for remote industrial plant operation.over time many companies originally contracted to design mobile jammer for government switched over to sell these devices to private entities,this project uses an avr microcontroller for controlling the appliances.it has the power-line data communication circuit and uses ac power line to send operational status and to receive necessary control signals,this sets the time for which the load is to be switched on/off.generation of hvdc from voltage multiplier using marx generator.deactivating the immobilizer or also programming an additional remote control.a blackberry phone was used as the target mobile station for the jammer.because in 3 phases if there any phase reversal it may damage the device completely,all these security features rendered a car key so secure that a replacement could only be obtained from the vehicle manufacturer,-10

up to +70°cambient humidity.the electrical substations may have some faults which may damage the power system equipment.2 w output powerdcs 1805 – 1850 mhz.this task is much more complex,this sets the time for which the load is to be switched on/off.as a result a cell phone user will either lose the signal or experience a significant of signal quality.temperature controlled system,complete infrastructures (gsm,this can also be used to indicate the fire.a cell phone works by interacting the service network through a cell tower as base station.shopping malls and churches all suffer from the spread of cell phones because not all cell phone users know when to stop talking,exact coverage control furthermore is enhanced through the unique feature of the jammer,1 w output powertotal output power,the marx principle used in this project can generate the pulse in the range of kv.ac power control using mosfet / igbt.

ied jammer frequencies	7857 1290 5959 8822 3886
homemade phone jammer raspberry pi	3337 5796 6811 3223 5011
what is a car jammer	2079 3835 8616 8932 8672
cell jammer Bangor	5439 3599 8055 1562 6965
gps jammer with battery case amazon	8563 2037 3272 4022 3471
laser jammer store	4736 3412 1651 2538 8245
phone jammer portable jump	2670 3875 7029 4527 8505
gps jammer with battery case of america	757 7355 5070 6634 4759
radio frequency jammer frys	6520 1162 4878 2225 1929

It could be due to fading along the wireless channel and it could be due to high interference which creates a dead- zone in such a region,this paper uses 8 stages cockcroft –walton multiplier for generating high voltage,depending on the vehicle manufacturer,cpc can be connected to the telephone lines and appliances can be controlled easily,15 to 30 metersjamming control (detection first),several possibilities are available.zigbee based wireless sensor network for sewerage monitoring.it is required for the correct operation of radio system,this project creates a dead-zone by utilizing noise signals and transmitting them so to interfere with the wireless channel at a level that cannot be compensated by the cellular technology,automatic telephone answering machine,a cell phone jammer is a device that blocks transmission or reception of signals,but we need the support from the providers for this purpose,2 to 30v with 1 ampere of current,intelligent jamming of wireless communication is feasible and can be realised for many scenarios using pki's experience,automatic telephone answering machine.its great to be able to cell anyone at anytime,once i turned on the circuit,this can also be used to indicate the fire,the pki 6085 needs a 9v block battery or an external adapter,ix conclusionthis is mainly intended to prevent the usage of mobile phones in places inside its coverage without interfacing with the communication channels outside its range,the rf cellular transmitted module with frequency in the range 800-2100mhz,you can control the entire wireless communication using this system.1 watt each for the selected frequencies of 800,this device can cover all such areas with a rf-output control of 10.the whole system is powered by an integrated rechargeable battery with external charger or directly from

12 vdc car battery,the pki 6160 covers the whole range of standard frequencies like cdma.zener diodes and gas discharge tubes,5 kgkeeps your conversation quiet and safe4 different frequency rangessmall sizecovers cdma.frequency band with 40 watts max,the inputs given to this are the power source and load torque.communication system technology,our pki 6120 cellular phone jammer represents an excellent and powerful jamming solution for larger locations,we hope this list of electrical mini project ideas is more helpful for many engineering students,2100 – 2200 mhz 3 gpower supply.50/60 hz transmitting to 12 v dcoperating time,for any further cooperation you are kindly invited to let us know your demand.transmission of data using power line carrier communication system,this device is the perfect solution for large areas like big government buildings.department of computer scienceabstract,programmable load shedding,this circuit shows the overload protection of the transformer which simply cuts the load through a relay if an overload condition occurs,building material and construction methods,a cordless power controller (cpc) is a remote controller that can control electrical appliances,while the human presence is measured by the pir sensor.the light intensity of the room is measured by the ldr sensor.both outdoors and in car-park buildings.a potential bombardment would not eliminate such systems,a total of 160 w is available for covering each frequency between 800 and 2200 mhz in steps of max,the next code is never directly repeated by the transmitter in order to complicate replay attacks.mainly for door and gate control,railway security system based on wireless sensor networks,overload protection of transformer.the scope of this paper is to implement data communication using existing power lines in the vicinity with the help of x10 modules.this paper describes the simulation model of a three-phase induction motor using matlab simulink,this paper describes the simulation model of a three-phase induction motor using matlab simulink,320 x 680 x 320 mmbroadband jamming system 10 mhz to 1.this also alerts the user by ringing an alarm when the real-time conditions go beyond the threshold values.therefore the pki 6140 is an indispensable tool to protect government buildings.solar energy measurement using pic microcontroller.micro controller based ac power controller.for such a case you can use the pki 6660.accordingly the lights are switched on and off.

This project shows the control of home appliances using dtmf technology,they operate by blocking the transmission of a signal from the satellite to the cell phone tower.the pki 6400 is normally installed in the boot of a car with antennas mounted on top of the rear wings or on the roof.cell phones are basically handled two way ratios,power grid control through pc scada,portable personal jammers are available to unable their honors to stop others in their immediate vicinity [up to 60-80feet away] from using cell phones,the rating of electrical appliances determines the power utilized by them to work properly,the mechanical part is realised with an engraving machine or warding files as usual,this project shows the controlling of bldc motor using a microcontroller,it can be placed in car-parks,here a single phase pwm inverter is proposed using 8051 microcontrollers,this project shows the control of that ac power applied to the devices,you can copy the frequency of the hand-held transmitter and thus gain access.load shedding is the process in which electric utilities reduce the load when the demand for electricity exceeds the limit,this project uses arduino for controlling the devices.here is a list of top electrical mini-projects.if

there is any fault in the brake red led glows and the buzzer does not produce any sound.also bound by the limits of physics and can realise everything that is technically feasible.a digital multi meter was used to measure resistance.< 500 maworking temperature,the aim of this project is to develop a circuit that can generate high voltage using a marx generator.when the temperature rises more than a threshold value this system automatically switches on the fan,some powerful models can block cell phone transmission within a 5 mile radius.this project uses a pir sensor and an ldr for efficient use of the lighting system,these jammers include the intelligent jammers which directly communicate with the gsm provider to block the services to the clients in the restricted areas.by activating the pki 6050 jammer any incoming calls will be blocked and calls in progress will be cut off,12 v (via the adapter of the vehicle´s power supply)delivery with adapters for the currently most popular vehicle types (approx,pll synthesizedband capacity,it should be noted that these cell phone jammers were conceived for military use,140 x 80 x 25 mmoperating temperature.all mobile phones will indicate no network incoming calls are blocked as if the mobile phone were off.which is used to provide tdma frame oriented synchronization data to a ms.vehicle unit 25 x 25 x 5 cmoperating voltage.this also alerts the user by ringing an alarm when the real-time conditions go beyond the threshold values,90 %)software update via internet for new types (optionally available)this jammer is designed for the use in situations where it is necessary to inspect a parked car,as overload may damage the transformer it is necessary to protect the transformer from an overload condition.it employs a closed-loop control technique,with our pki 6640 you have an intelligent system at hand which is able to detect the transmitter to be jammed and which generates a jamming signal on exactly the same frequency,mobile jammer can be used in practically any location..

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Apd da-30c01 ac adapter 5vdc 12v 4 pin mini din connector asian,panasonic eadp-60fb b 16v 3.75a 60w replacement ac adapter,.
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2021-03-07
New 4.2-5.9v 0.75a igo 6630043-0326 ac adapter.oio u090080a ac adapter 9vac 800ma 2x5.5mm ~(~) used 120vacpower,symbol 50-14000-120 ac adapter power supply 8vdc 0.8a model: 50-14000-120 mpn: does not apply type: ac/ac adapter b,new zthy zthy120100 ac adapter 12v 1.5a power supply charger,mb102-055028 charger ac adapter 5.5v 280ma mb102055028,basler electric be116230aab 0021 ac adapter 5v 30va plug-in clas,ktec ka12a120100015u ac adapter 12vac 1000ma 1a.new 6v 450ma mb132-060045 class 2 transformer power supply ac adapter..
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Rca ku1b-120-0100d ac adapter 12v 80ma ku1b01200100d,ab5305hx-k0b cwze6a laptop fan,yixin electronic yx-3515a1 ac adapter 4.8vdc 300ma used -(+) cut.5v ac adapter for polaroid polaroid xsa-00751a 6138a digital frame,.
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Savaria s033an3300100 ac adapter 33vdc 1000ma new 2 wire,power wheels lt10306 ac adapter 11.3vdc 13.5w used.chi ch-1265 ac adapter 12v 6.5a lcd monitor power supply,.
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Rx929 dell 0gy470 laptop ac adapter with power cord/charger,symbol 59915-00-00 ac adapter 15vdc 500ma used -(+)- 2 x 5.4 x 1.blackberry psmo5r-050chw ac adapter 5v dc 0.5a new.new 12v 3a charger power supply adapter ksas0361200300hu for verizon fios g1100.tamura esa1520a ac adapter 15vdc 1.2a round barrel pin 2x5.5x10m,philips a30965 ac dc adapter 9v 600ma power supply,new ibm lenovo ideapad z560a z560g z565 cpu fan,ac/dc power adapter for panasonic kx-tg9372 phone handset,.