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Permanent Link to Innovation: Multipath Minimization Method
2021/06/16

Mitigation Through Adaptive Filtering for Machine Automation Applications By Luis Serrano, Don Kim, and Richard B. Langley Multipath is real and omnipresent, a detriment when GPS is used for positioning, navigation, and timing. The authors look at a technique to reduce multipath by using a pair of antennas on a moving vehicle together with a sophisticated mathematical model. This reduces the level of multipath on carrier-phase observations and thereby improves the accuracy of the vehicle's position. INNOVATION INSIGHTS by Richard Langley "OUT, DAMNED MULTIPATH! OUT, I SAY!" Many a GPS user has wished for their positioning results to be free of the effect of multipath. And unlike Lady Macbeth's imaginary blood spot, multipath is real and omnipresent. Although it may be considered beneficial when GPS is used as a remote sensing tool, it is a detriment when GPS is used for positioning, navigation, and timing — reducing the achievable accuracy of results. Clearly, the best way to reduce the effects of multipath is to try avoiding it in the first place by siting the receiver's antenna as low as possible and far away from potential reflectors. But that's not always feasible. The next best approach is to reduce the level of the multipath signal entering the receiver by attenuating it with a suitably designed antenna. A large metallic ground plane placed beneath an antenna will modify the shape of the antenna's reception pattern giving it reduced sensitivity to signals arriving at low elevation angles and from below the antenna's horizon. So-called choke-ring antennas also significantly attenuate multipath signals. And microwave-absorbing materials appropriately placed in an antenna's vicinity can also be beneficial. Multipath can also be mitigated by special receiver correlator designs. These designs target the effect of multipath on code-phase measurements and the resulting pseudorange observations. Several different proprietary implementations in commercial receivers significantly reduce the level of multipath in the pseudoranges and hence in pseudorange-based position and time estimates. Some degree of multipath attenuation can be had by using the low-noise carrier-phase measurements to smooth the pseudoranges before they are processed. The effect of multipath on carrier phases is much smaller than that on pseudoranges. In fact, it is limited to only one-quarter of the carrier wavelength when the reflected signal's amplitude is less

than that of the direct signal. This means that at the GPS L1 frequency, the multipath contamination in a carrier-phase measurement is at most about 5 centimeters. Nevertheless, this is still unacceptably large for some high-accuracy applications. At a static site, with an unchanging multipath environment, the signal reflection geometry repeats day to day and the effect of multipath can be reduced by sidereal filtering or “stacking” of coordinate or carrier-phase-residual time series. However, this approach is not viable for scenarios where the receiver and antenna are moving such as in machine control applications. Here an alternative approach is needed. In this month’s column, I am joined by two of my UNB colleagues as we look at a technique that uses a pair of antennas on a moving vehicle together with a sophisticated mathematical model, to reduce the level of multipath on carrier-phase observations and thereby improve the accuracy of the vehicle’s position. Real-time-kinematic (RTK) GNSS-based machine automation systems are starting to appear in the construction and mining industries for the guidance of dozers, motor graders, excavators, and scrapers and in precision agriculture for the guidance of tractors and harvesters. Not only is the precise and accurate position of the vehicle needed but its attitude is frequently required as well. Previous work in GNSS-based attitude systems, using short baselines (less than a couple of meters) between three or four antennas, has provided results with high accuracies, most of the time to the sub-degree level in the attitude angles. If the relative position of these multiple antennas can be determined with real-time centimeter-level accuracy using the carrier-phase observables (thus in RTK-mode), the three attitude parameters (the heading, pitch, and roll angles) of the platform can be estimated. However, with only two GNSS antennas it is still possible to determine yaw and pitch angles, which is sufficient for some applications in precision agriculture and construction. Depending on the placement of the antennas on the platform body, the determination of these two angles can be quite robust and efficient. Nevertheless, even a small separation between the antennas results in different and decorrelated phase-multipath errors, which are not removed by simply differencing measurements between the antennas. The mitigation of carrier-phase multipath in real time remains, to a large extent, very limited (unlike the mitigation of code multipath through receiver improvements) and it is commonly considered the major source of error in GNSS-RTK applications. This is due to the very nature of multipath spectra, which depends mainly on the location of the antenna and the characteristics of the reflector(s) in its vicinity. Any change in this binomial (antenna/reflectors), regardless of how small it is, will cause an unknown multipath effect. Using typical choke-ring antennas to reduce multipath is typically not practical (not to mention cost prohibitive) when employing multiple antennas on dynamic platforms. Extended flat ground planes are also impractical. Furthermore, such antenna configurations typically only reduce the effects of low angle reflections and those coming from below the antenna horizon. One promising approach to mitigating the effects of carrier-phase multipath is to filter the raw measurements provided by the receiver. But, unlike the scenario at a fixed site, the multipath and its effects are not repeatable. In machine automation applications, the machinery is expected to perform complex and unpredictable maneuvers; therefore the removal of carrier-phase multipath should rely on smart digital filtering techniques that adapt not only to the background multipath (coming mostly from the machine’s reflecting surfaces), but also to the changing multipath environment along

the machine's path. In this article, we describe how a typical GPS-based machine automation application using a dual-antenna system is used to calibrate, in a first step, and then remove carrier-phase multipath afterwards. The intricate dynamical relationship between the platform's two "rover" antennas and the changing multipath from nearby reflectors is explored and modeled through several stochastic and dynamical models. These models have been implemented in an extended Kalman filter (EKF).

MIMICS Strategy Any change in the relative position between a pair of GNSS antennas most likely will affect, at a small scale, the amplitude and polarization of the reflected signals sensed by the antennas (depending on their spacing). However, the phase will definitely change significantly along the ray trajectories of the plane waves passing through each of the antennas. This can be seen in the equation that describes the single-difference multipath between two close-by antennas (one called the "master" and the other the "slave"):

$$\Phi_m - \Phi_s = \frac{2\pi}{\lambda} (\rho_m - \rho_s) + \alpha_0 + \epsilon \quad (1)$$

where α_0 is the relative multipath phase delay between the antennas and a nearby effective reflector (α_0 is the multipath signal amplitude in the master and slave antennas, and is dependent on the reflector characteristics, reflection coefficient, and receiver tracking loop). As our study has the objective to mimic as much as possible the multipath effect from effective reflectors in kinematic scenarios with variable dynamics, we decided to name the strategy MIMICS, a slightly contrived abbreviation for "Multipath profile from between receivers dynaMICS." The MIMICS algorithm for a dual-antenna system is based on a specular reflector ray-tracing multipath model (see Figure 1).

Figure 1. 3D ray-tracing modeling of phase multipath for a GNSS dual-antenna system. 0 designates the "master" antenna; 1, the "slave" antenna; Elev and Az, the elevation angle and the azimuth of the satellite, respectively. The other symbols are explained in the text. After a first step of data synchronization and data-snooping on the data provided by the two receiver antennas, the second step requires the calculation of an approximate position for both antennas, relaxed to a few meters using a standard code solution. A precise estimation of both antennas' velocity and acceleration (in real time) is carried out using the carrier-phase observable. Not only should the antenna velocity and acceleration estimates be precisely determined (on the order of a few millimeters per second and a few millimeters per second squared, respectively) but they should also be immune to low-frequency multipath signatures. This is important in our approach, as we use the antennas' multipath-free dynamic information to separate the multipath in the raw data. We will start from the basic equations used to derive the single-difference multipath observables. The observation equation for a single-difference between receivers, using a common external clock (oscillator), is given (in distance units) by:

$$\Phi_m - \Phi_s = \frac{2\pi}{\lambda} (\rho_m - \rho_s) + N(\lambda - \lambda_m) + M + \epsilon \quad (2)$$

where m indicates the master antenna; s , the slave antenna; prn , the satellite number; Δ , the operator for single differencing between receivers; Φ , the carrier-phase observation; ρ , the slant range between the satellite and receiver antennas; N , the carrier-phase ambiguity; M , the multipath; and ϵ , the system noise. By sequentially differencing Equation (2) in time to remove the single-difference ambiguity from the observation equation, we obtain (as long as there is no loss of lock or cycle slips):

$$\Phi_m - \Phi_s = \frac{2\pi}{\lambda} (\rho_m - \rho_s) + M + \epsilon \quad (3)$$

where (4) One of the key ideas in deriving the multipath observable from Equation (3) is to estimate M given by Equation (4). We will outline our approach in a later section. From Equation (3), at the second epoch, for example, we will have:

$$\Phi_m - \Phi_s = \frac{2\pi}{\lambda} (\rho_m - \rho_s) + M + \epsilon \quad (5)$$

If we continue this process up to epoch n , we will obtain an ensemble of differential multipath observations. If we then take the

numerical summation of these, we will have (6) Note that n samples of differential multipath observations are used in Equation (6). Therefore, we need $n + 1$ observations. Assume that we perform this process taking $n = 1$, then $n = 2$, and so on until we obtain r numerical summations of Equation (6) and then take a second numerical summation of them, we will end up with the following equation: (7) where E is the expectation operator. Another key idea in our approach is associated with Equation (7). To isolate the initial epoch multipath, ϵ_0 , from the differential multipath observations, the first term on the right-hand side of Equation (7), ϵ_0 , should be removed. This can be accomplished by mechanical calibration and/or numerical randomization. To summarize the idea, we have to create random multipath physically (or numerically) at the initialization step. When the isolation of the initial multipath epoch is completed, we can recover multipath at every epoch using Equation (5).

Digital Differentiators. We introduce digital differentiators in our approach to derive higher order range dynamics (that is, range rate, range-rate change, and so on) using the single-difference (between receivers connected to a common external oscillator) carrier-phase observations. These higher order range dynamics are used in Equation (4). There are important classes of finite-impulse-response differentiators, which are highly accurate at low to medium frequencies. In central-difference approximations, both the backward and the forward values of the function are used to approximate the current value of the derivative. Researchers have demonstrated that the coefficients of the maximally linear digital differentiator of order $2N + 1$ are the same as the coefficients of the easily computed central-difference approximation of order N . Another advantage of this class is that within a certain maximum allowable ripple on the amplitude response of the resultant differentiator, its pass band can be dramatically increased. In our approach, this is something fundamental as the multipath in kinematic scenarios is conceptually treated as high-frequency correlated multipath, depending on the platform dynamics and the distance to the reflector(s).

Adaptive Estimation. To derive single-difference multipath at the initial epoch, ϵ_0 , a numerical randomization (or mechanical calibration) of the single-difference multipath observations is performed in our approach. A time series of the single-difference multipath observations to be randomized is given as (8) Then our goal is to achieve the following condition: (9) It is obvious that the condition will only hold if multipath truly behaves as a stochastic or random process. The estimation of multipath in a kinematic scenario has to be understood as the estimation of time-correlated random errors. However, there is no straightforward way to find the correlation periods and model the errors. Our idea is to decorrelate the between-antenna relative multipath through the introduction of a pseudorandom motion. As one cannot completely rely only on a decorrelation through the platform calibration motion, one also has to do it through the mathematical “whitening” of the time series. Nevertheless, the ensemble of data depicted in the above formulation can be modeled as an oscillatory random process, for which second or higher order autoregressive (AR) models can provide more realistic modeling in kinematic scenarios. (An autoregressive process is simply another name for a linear difference equation model where the input or forcing function is white Gaussian noise.) We can estimate the parameters of this model in real time, in a block-by-block analysis using the familiar Yule-Walker equations. A whitening filter can then be formed from the estimation parameters. We obtain the AR coefficients using the autocorrelation

coefficient vector of the random sequences. Since the order of the coefficient estimation depends on the multipath spectra (in turn dependent on the platform dynamics and reflector distance), MIMICS uses a cost function to estimate adaptively, in real time, the appropriate order. An order too low results in a poor whitener of the background colored noise, while an order too large might affect the embedded original signal that we are interested in detecting. The cost function uses the residual sum of squared error. The order estimate that gives the lowest error is the one chosen, and this task is done iteratively until it reaches a minimum threshold value. Once this stage is fulfilled, the multipath observable can be easily obtained.

Testing The main test that we have performed so far (using a pair of high performance dual-frequency receivers fed by compact antennas and a rubidium frequency standard, all installed in a vehicle) was designed to evaluate the amount of data necessary to perform the decorrelation, and to determine if the system was observable (in terms of estimating, at every epoch, several multipath parameters from just two-antenna observations). Receiver data was collected and post-processed (so-called RTK-style processing) although, with sufficient computing power, data processing could take place in real, or near real, time. In a real-life scenario, the platform pseudorandom motions have the advantage that carrier-phase embedded dynamics are typically changing faster and in a three-dimensional manner (antennas sense different pitch and yaw angles). Thus a faster and more robust decorrelation is possible. One can see from the bottom picture in Figure 2 the façade of the building behaving as the effective reflector. The vehicle performed several motions, depicted in the bottom panel of Figure 3, always in the visible parking lot, hence the building constantly blocked the view to some satellites. We used only the L1 data from the receivers recorded at a rate of 10 Hz. In the bottom panel of Figure 3, one can also see the kind of motion performed by the platform. Accelerations, jerk, idling, and several stops were performed on purpose to see the resultant multipath spectra differences between the antennas. The reference station (using a receiver with capabilities similar to those in the vehicle) was located on a roof-top no more than 110 meters away from the vehicle antennas during the test. As such, most of the usual biases were removed from the solution in the differencing process and the only remaining bias can be attributed to multipath. The data from the reference receiver was only used to obtain the varying baseline with respect to the vehicle master antenna. In the top panel of Figure 3, one can see the geometric distance calculated from the integer-ambiguity-fixed solutions of both antenna/receiver combinations. Since the distance between the mounting points on the antenna-support bar was accurately measured before the test (84 centimeters), we had an easy way to evaluate the solution quality. The “outliers” seen in the figure come from code solutions because the building mentioned before blocked most of the satellites towards the southeast. As a result, many times fewer than five satellites were available. Figure 3. Correlation between vehicle dynamics (heading angle) and the multipath spectra. Looking at the first nine minutes of results in Figure 4, one can see that when the vehicle is still stationary, the multipath has a very clear quasi-sinusoidal behavior with a period of a few minutes. Also, one can see that it is zero-mean as expected (unlike code multipath). When the vehicle starts moving (at about the four-minute mark), the noise figure is amplified (depending on the platform velocity), but one can still see a mixture of low-frequency components coming from

multipath (although with shorter periods). These results indicate, firstly, that regardless of the distance between two antennas, multipath will not be eliminated after differencing, unlike some other biases. Secondly, when the platform has multiple dynamics, multipath spectra will change accordingly starting from the low-frequency components (due to nearby reflectors) towards the high-frequency ones (including diffraction coming from the building edges and corners). As such, our approach to adaptively model multipath in real time as a quasi-random process makes sense. Figure 4. Position results from the kinematic test, showing the estimated distance between the two vehicle antennas (upper plot) and the distance between the master antenna and the reference antenna. Multipath Observables. The multipath observables are obtained through the MIMICS algorithm. It is quite flexible in terms of latency and filter order when it comes to deriving the observables. Basically, it is dependent on the platform dynamics and the amplitude of the residuals of the whitened time series (meaning that if they exceed a certain threshold, then the filtering order doesn't fit the data). When comparing the observations delivered every half second for PRN 5 with the ones delivered every second, it is clear that the larger the interval between observations, the better we are able to recover the true biased sinusoidal behavior of multipath. However, in machine control, some applications require a very low latency. Therefore, there must be a compromise between the multipath observable accuracy and the rate at which it is generated. Multipath Parameter Estimation. Once the multipath observables are derived, on a satellite-by-satellite basis, it is possible to estimate the parameters (a_0 , the reflection coefficient; γ_0 , the phase delay; ϕ_0 , the azimuth of reflected signal; and θ_0 , the elevation angle of reflected signal) of the multipath observable described in Equation (1) for each satellite. As mentioned earlier, an EKF is used for the estimation procedure. When the platform experiences higher dynamics, such as rapid rotations, acceleration is no longer constant and jerk is present. Therefore, a Gauss-Markov model may be more suitable than other stochastic models, such as random walk, and can be implemented through a position-velocity-acceleration dynamic model. As an example, the results from the multipath parameter estimation are given for satellite PRN 5 in Figure 5. One can see that it takes roughly 40 seconds for the filter to converge. This is especially seen in the phase delay. Converted to meters, the multipath phase delay gives an approximate value of 10 meters, which is consistent with the distance from the moving platform to the dominant specular reflector (the building's façade). Figure 5. PRN 5 multipath parameter estimation. Multipath Mitigation. After going through all the MIMICS steps, from the initial data tracking and synchronization between the dual-antenna system up to the multipath parameter estimation for each continuously observed satellite, we can now generate the multipath corrections and thus correct each raw carrier-phase observation. One can see in Figure 6 three different plots from the solution domain depicting the original raw (multipath-contaminated) GPS-RTK baseline up-component (top), the estimated carrier-phase multipath signal (middle), and the difference between the two above time series; that is, the GPS-RTK multipath-ameliorated solution (bottom). A clear improvement is visible. In terms of numbers, and only considering the results "cleaned" from outliers and differential-code solutions (provided by the RTK post-processing software, when carrier-phase ambiguities cannot be fixed), the up-component root-mean-square value before was 2.5 centimeters, and after applying MIMICS it stood at 1.8 centimeters.

Figure 6. MIMICS algorithm results for the vehicle baseline from the first 9 minutes of the test.

Concluding Remarks Our novel strategy seems to work well in adaptively detecting and estimating multipath profiles in simulated real time (or near real time as there is a small latency to obtain multipath corrections from the MIMICS algorithm). The approach is designed to be applied in specular-rich and varying multipath environments, quite common at construction sites, harbors, airports, and other environments where GNSS-based heading systems are becoming standard. The equipment setup can be simplified, compared to that used in our test, if a single receiver with dual-antenna inputs is employed. Despite its success, there are some limitations to our approach. From the plots, it's clear that not all multipath patterns were removed, even though the improvements are notable. Moreover, estimating multipath adaptively in real time can be a problem from a computational point of view when using high update rates. And when the platform is static and no previous calibration exists, the estimation of multipath parameters is impossible as the system is not observable. Nevertheless, the approach shows promise and real-world tests are in the planning stages.

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Manufacturers The test of the MIMICS approach used two NovAtel OEM4 receivers in the vehicle each fed by a separate NovAtel GPS-600 "pinwheel" antenna on the roof. A Temex Time (now Spectratime) LPFRS-01/5M rubidium frequency standard supplied a common oscillator frequency to both receivers. The reference receiver was a Trimble 5700, fed by a Trimble Zephyr geodetic antenna.

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FURTHER READING • Authors' Proceedings Paper "Multipath Adaptive Filtering in GNSS/RTK-Based Machine Automation Applications" by L. Serrano, D. Kim, and R.B. Langley in Proceedings of PLANS 2010, IEEE/ION Position Location and Navigation Symposium, Indian Wells, California, May 4-6, 2010, pp. 60-69, doi: 10.1109/PLANS.2010.5507201. • Pseudorange and Carrier-Phase Multipath Theory and Amelioration Articles from GPS World "It's Not All Bad: Understanding and Using GNSS Multipath" by A. Bilich and K.M. Larson in GPS World, Vol. 20, No. 10, October 2009, pp. 31-39. "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

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Clean probes were used and the time and voltage divisions were properly set to ensure the required output signal was visible, due to its sympathectomy-like vasodilation promoting blood flow. philips ay3170/17 ac adapter 4.5vdc 300ma used 1.7 x 4 x 9.7 mm, datalogic sc102ta0942f02 ac adapter 9vdc 1.67a +(-) 2x5.5mm ault, from analysis of the frequency range via useful signal analysis. fujitsu fmv-ac317 ac adapter 16vdc 3.75a used cp171180-01, cincon tr100a240 ac adapter 24vdc 4.17a 90degree round barrel 2., archer 273-1652a ac adapter 12vdc 500ma used -(+) 2x5.5mm round, acbel api3ad14 ac adapter 19vdc 6.3a used (: :) female 4pin fema, dvacs dv-1250 ac adapter 12vdc 0.5a used 2 x 5.4 x 11.9mm, basler electric be117125bbb0010 ac adapter 18vac 25va, madcatz 2752 ac adapter 12vdc 340ma used -(+) class 2 power supp, hipower ea11603 ac adapter 18-24v 160w laptop power supply 3x6.5. ryobi 1400666 charger 14vdc 2a 45w for cordless drill 1400652 ba, dc12500 ac adapter 12vdc 500ma power supply class 2 transformer, apple powerbook m1893 ac adapter 16vdc 1.5a 16v 1a used 4 pin di, ibm 08k8204 ac adapter 16vdc 4.5a -(+) 2.5x5.5mm 100-240vac used, as overload may damage the transformer it is necessary to protect the transformer from an overload condition. 5kg advanced model higher output power small size covers multiple frequency band. katana ktp-0101 ac adapter 5vdc 2a used 1.8x4x10mm, advent t ha57u-560 ac adapter 17vdc 1.1a -(+) 2x5.5mm 120vac use. li shin 0335c1960 ac adapter 19vdc 3.16a -(+) 3.3x5.5mm tip in 1, sadp-65kb b ac switching adapter 19v 1.58a -(+) 1.8x5mm used 10, mw mw48-9100 ac dc adapter 9vdc 1000ma used 3 pin molex power su. 0335c2065 advent ac dc adapter 20v 3.25a charger power supply la, potrans up04821120a ac adapter 12vdc 4a used -(+) 2x5.5x9.7mm ro, this paper describes the

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signal jammer detector finds	6882

Micron nbp001088-00 ac adapter 18.5v 2.45a used 6.3 x 7.6 mm 4 p.compaq presario ppp005l ac adapter 18.5vdc 2.7a for laptop,if there is any fault in the brake red led glows and the buzzer does not produce any sound.aplha concord dv-1215a ac adapter 12vac,techno earth 60w-12fo ac adapter 19vdc 3.16a used 2.6 x 5.4 x 11,liteon pa-1900-24 ac adapter 19v 4.74a acer gateway laptop power,5.2vdc 450ma ac adapter used phone connector plug-in.casio ad-c59200u ac adapter 5.9vdc 2a power supply.hp ppp012s-s ac adapter 19v dc 4.74a used 5x7.3x12.6mm straight,mastercraft maximum dc14us21-60a battery charger 18.8vdc 2a used.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,delta eadp-18cb a ac adapter 48vdc 0.375a used -(+) 2.5x5.5mm ci,the aim of this project is to develop a circuit that can generate high voltage using a marx generator,here is a list of top electrical mini-projects,blueant ssc-5w-05 050050 ac adapter 5v 500ma used usb switching,hitachi pc-ap4800 ac adapter 19vdc 2.37a used -(+)- 1.9 x 2.7 x.3 w output powergsm 935 - 960 mhz.edac ea1060b ac adapter 18-24v dc 3.2a used 5.2 x 7.5 x 7.9mm st,zyxel a48091000 ac adapter 9v 1000ma used 3pin female class 2 tr,optionally it can be supplied with a socket for an external antenna.nintendo ds dsi car adapter 12vdc 4.6vdc 900ma used charger bric.computer products cl40-76081 ac adapter 12vdc 0.35a 6pin power s,chd scp0501500p ac adapter 5vdc 1500ma used -(+) 2x5.5x10mm roun,panasonic re7-25 ac adapter 5vdc 1000ma used 2 hole pin.sonigem gmrs battery charger 9vdc 350ma used charger only no ac,when zener diodes are operated in reverse bias at a particular voltage level,digipower tc-500 solutions world travel chargerscanon battery,best a7-1d10 ac dc adapter 4.5v 200ma power supply.dish networkkault p57241000k030g ac adapter 24vdc 1a -(+) 1x3.5mm.sparkle power spa050a48a ac adapter 48vdc 1.04a used -(+)- 2.5 x,additionally any rf output failure is indicated with sound alarm and led display.

This project uses a pir sensor and an ldr for efficient use of the lighting system,kensington 38004 ac adapter 0-24vdc 0-6.5a 120w used 2.5x5.5x12m.finecom ac adapter yamet plug not included 12vac 20-50w electron,ae9512 ac dc adapter 9.5v 1.2a class 2 power unit power supply,.

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- [signal jammer in hospital](#)
- [signal jammer dhgate](#)
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Email:aTE_Nb0T@gmail.com

2021-06-15

Ceiva e-awb100-050a ac adapter +5vdc 2a used -(+) 2x5.5mm digita,delta sadp-65kb d ac adapter 19vdc 3.42a used -(+)- 2.5x5.5mm 10.apple m7332 yoyo ac adapter 24vdc 1.875a 3.5mm 45w with cable po,raheem is described to be around 6-2 with a slim build.mastercraft sa41-6a battery charger 7.2vdc used -(+) power supply,panasonic cf-aa1653 j2 ac adapter 15.6v 5a power supply universa,anoma electric aec-t5713a ac adapter 13.5vdc 1.5a power supply.mw psu25a-14e ac adapter 5vdc 2.5a +/-15v used 5pin 13mm din mea,.

Email:YIWEZ_AD3Vs9HW@aol.com

2021-06-13

Oem ad-2430 ac adapter 24vdc 300ma used -(+) stereo pin plug-in,integrated inside the briefcase,the marx principle used in this project can generate the pulse in the range of kv.ge 5-1075a ac adapter 6vdc 200ma 7.5v 100ma used -(+) 2x5x10.9mm..

Email:NTF_9kqxUoy@aol.com

2021-06-11

Simple mobile jammer circuit diagram,airlink wrg10f-120a ac adapter 12vdc 0.83a -(+) 2x5.5mm 90° powe.k090050d41 ac adapter 9vdc 500ma 4.5va used -(+) 2x5.5x12mm 90°r.icm06-090 ac adapter 9vdc 0.5a 6w used -(+) 2x5.5x9mm round barr.signal jammer is a device that blocks transmission or reception of signals..

Email:Hro1_ige@aol.com

2021-06-10

Ar 35-12-150 ac dc adapter 12v 150ma transmitter's power supply.6 different bands

(with 2 additional bands in option) modular protection, ua075020e ac adapter 7.5vac 200ma used 1.4 x 3.3 x 8 mm 90.nokia ac-4x ac adapter 5vdc 890ma used 1 x 2 x 6.5mm, this device is the perfect solution for large areas like big government buildings, 5g modules are helping accelerate the IoT's development, jabra ssa-5w-05 us 0500018f ac adapter 5vdc 180ma used -(+) usb.dell pa-16 /pa16 ac adapter 19v dc 3.16a 60watts desktop power..

Email: pmax_Blv@yahoo.com

2021-06-08

T-n0-3300 ac adapter 7.6v dc 700ma power supply travel charger, ps0538 ac adapter 5vdc 3.5a - 3.8a used -(+) - 1.2 x 3.4 x 9.3 mm, 03-00050-077-b ac adapter 15v 200ma 1.2 x 3.4 x 9.3mm, biogenik s12a02-050a200-06 ac adapter 5vdc 2a used -(+) 1.5x4x9mm, oem ad-0760dt ac adapter 7.5vdc 600ma used -(+) - 2.1x5.4x10mm, ar 48-15-800 ac dc adapter 15v 800ma 19w class 2 transformer. csd0900300u-22 ac adapter 9vdc 300ma used 2 x 5.5 x 12mm,.