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Permanent Link to Innovation: Hybrid Positioning
2021/06/19
A Prototype System for Navigation in GPS-Challenged Environments By Chris Rizos, Dorota A. Grejner-Brzezinska, Charles K. Toth, Andrew G. Dempster, Yong Li, Nonie Politi, Joel Barnes, Hongxing Sun, and Leilei Li A team of Australian and U.S. researchers have integrated a ground-based system with GPS and INS to create a hybrid system that provides precise and accurate position information continuously in a variety of environments where GPS alone comes up short. INNOVATION INSIGHTS by Richard Langley GPS HAS ITS LIMITATIONS. Although it is a 24/7 global system, it doesn't work everywhere. The microwave radio signals transmitted by the satellites are rather weak, and although they can provide excellent positioning performance when a receiver's antenna has a direct line-of-sight view of a sufficient number of satellites well spread out in the sky, positioning accuracy degrades or becomes impossible when the signals are effectively blocked by obstacles such as trees, rock faces, and buildings outdoors and by roofs, ceilings, and walls indoors. In many obstructed environments, the signals aren't completely blocked but rather their power is severely attenuated so that they are no longer strong enough to be acquired and tracked by a conventional GPS receiver. Remarkable progress has been made in the development of super-sensitive receivers that, in conjunction with an appropriate antenna and assistance information provided over a mobile phone network, can provide position fixes in such environments. However, the precisions and accuracies of these pseudorange-based positions are often very poor — perhaps as low as 100 meters or more. So, is it possible to obtain precise and accurate positions in obstructed environments? Well, we could add measurements from GLONASS (or other satellites) to GPS measurements, but GLONASS suffers the same problem as GPS, and while the additional satellites could be an advantage in some partially obscured areas there are many places where we won't be any better off. We could use an inertial navigation system (INS), but such devices have their own weaknesses such as the requirement of initial calibration and the accumulation of position error with time. Are there any other technologies available? We know GPS works very well when there is a direct line-of-sight view between the satellite transmitters and the receivers and carrier-phase measurements can provide decimeter- and even

centimeter-accuracies. So why not develop a ground-based system that works in a similar way to GPS, which would allow you to place the transmitters wherever you like? Well, such a system has indeed been developed and in this month's column, a team of Australian and U.S. researchers describes how they integrated the ground-based system together with GPS and INS to create a hybrid system that provides precise and accurate position information continuously in a variety of environments where GPS alone comes up short. "Innovation" features discussions about advances in GPS technology, its applications, and the fundamentals of GPS positioning. The column is coordinated by Richard Langley, Department of Geodesy and Geomatics Engineering, University of New Brunswick. The determination of the position and orientation (or "pointing direction") of a device (or platform to which it is attached), to high accuracy, in all outdoor environments, using reliable and cost-effective technologies is something of a "holy grail" quest for navigation researchers and engineers. However, ongoing research has identified two classes of applications that place stringent demands on the positioning/orientation device: (a) man-portable mapping and imaging systems that operate in a range of difficult urban and rural environments, often used for the detection of underground utility assets (such as pipelines, cables, conduits), unexploded ordnances and buried objects, and (b) the guidance/control of construction or mining equipment in environments where good "sky view" is not guaranteed. The solution to this positioning/orientation problem is increasingly seen as being based on an integration of several technologies: satellite (GNSS including GPS) and terrestrial ranging systems, inertial navigation systems (INSs), laser guidance/scanning systems, and even electro-optical devices such as surveyors' total stations or laser scanners. Each has its shortcomings, but within an integrated system, advantage can be taken of the complementary characteristics of several of these sensor technologies. Centimeter-level accuracy positioning systems for outdoor use typically have at their core the GPS technology. GPS is, in fact, the most effective general-purpose navigation tool ever developed because of its ability to address a wide variety of applications: air, sea, land, and space navigation; precise timing; geodesy; surveying and mapping; machine guidance/control; military and emergency services operations; hiking and other leisure activities; personal location; and location-based services. The varied applications use different and appropriate receiver instrumentation, operational procedures, and data processing techniques. But all require signal availability from a minimum of four GPS satellites for three-dimensional fixes. However, one of the usual limiting factors in using GPS is the need for direct line-of-sight between the satellites and the ground receiver. In particular, the robustness of positioning is compromised when GPS receivers are near or under trees, in urban/suburban areas, or in deep open-pit mines and construction sites, where there is partial sky view obstruction by buildings or walls. The traditional means of overcoming the gaps in navigation coverage due to satellite signal blockages is to use an INS. An INS (with its inertial measurement unit or IMU) is also the most convenient means of determining the orientation of the device or platform. The integration of GPS and INS can, in principle, overcome the defects of standalone INS (sensor errors that grow unbounded with time) and GPS (signal availability requirement). But navigation accuracy degrades rapidly if there are no GPS measurements to calibrate the INS sensor errors. A new terrestrial RF-based distance measurement technology offers promise of continuous signal coverage, even in difficult urban/rural environments. This technology is known as “Locata.” The Locata approach is to deploy a network of ground-based transceivers that cover an area with strong time-synchronized ranging signals. When a Locata receiver uses four or more ranging signals it can compute a high-accuracy position entirely independent of GPS or INS. However, a standalone Locata receiver has its own shortcomings: (a) in some situations it may be difficult to achieve good vertical dilution of precision due to logistical constraints of placing transmitters (to give a variation in elevation angle between the terrestrial transmitters and the receiver whose positions are to be determined), and (b) as with GPS, multiple receivers/antennas are required to derive orientation information. What is therefore required is several carefully selected navigation sensor technologies, integrated within a single hardware package, the measurements from which are simultaneously processed to provide continuous, reliable, and accurate navigation solutions (that is, both position and orientation information). In cooperation with Locata Corporation, the SNAP Laboratory within the School of Surveying and Spatial Information Systems at the University of New South Wales (UNSW) and the SPIN Laboratory at The Ohio State University have assembled a working prototype of a hybrid system based on GPS, inertial navigation, and Locata receiver technology to provide seamless and reliable navigation aimed at supporting vehicle guidance and control, open-pit mining, mobile and GIS mapping, and industrial applications. Locata Technology The SNAP Lab has been conducting pseudolite research for many years, and has experimented with pseudolites in nonsynchronous and synchronized modes for a variety of applications, using both the GPS L1 frequency as well as the 2.4 GHz ISM band frequencies. Locata Corporation has developed state-of-the-art RF terrestrial positioning technology (“Locata”), which consists of a network (“LocataNet”) of time-synchronized pseudolite-like transceivers (“LocataLites”). UNSW has assisted in the development of the technology through experimental testing and benchmarking. In a relatively open outdoor environment, the LocataNet can provide real-time stand-alone kinematic positioning (without a base station) at centimeter-level accuracy. Even in an indoor environment where LocataLite signals arrive at a Locata receiver via non-line-of-sight paths (penetrating the walls of buildings), the static positioning quality can be at the sub-centimeter level, and also at the sub-meter level for kinematic positioning. Locata has several advanced features that have been developed over a period of about 10 years through several technology generations, including a time-synchronized positioning network, network propagation to many LocataLites, improved signal penetration, change of transmitting frequency and signal structure, and spatial and frequency diversity. In TABLE 1, the key characteristics of the two generations of Locata technology are listed. Using 2.4 GHz not only means the frequency is license-free, but also permits transceiver output power of up to 1 watt, which means greater operating distances (up to 10 kilometers). Using dual-frequency signals changes the initial phase-bias resolution from known-point initialization to on-the-fly (OTF), where the initial phase bias is resolved while the receiver is moving. The higher chipping rate (10 MHz) results in less pseudorange multipath error, because the delay in a reflected signal will rarely be more than two chips. The 10-Hz measurement rate allows relatively high velocities of the receiver. Table 1. Specification summary of Locata’s first- and second-generation systems. In terrestrial-based RF-based positioning, multipath error is more severe than with GPS, because the terrestrially transmitted signal arrives at the receiver at a very low (typically less than 10 degrees) or even a negative elevation angle, which can result in severe multipath signal fading. In the second-generation Locata system, spatial and frequency diversity techniques are employed. Spatial and frequency diversity are two of the three types of diversity principles (the other being polarization) that are common practices in terrestrial RF communications to mitigate against signal fading. The LocataLite transceiver uses two spatially separated (usually in the vertical) antennas, which transmit two signals at different frequencies. This gives a cluster of four diverse signals transmitted from one LocataLite. With this diversity technology, Locata kinematic positioning in moderately obstructed environments can provide centimeter-level quality with 100-percent coverage, as well as consistent geometry and high reliability. The Locata's multipath mitigation technology is very important and relevant to this project, because the operational environments are often vegetated or wooded. Triple Integration As discussed in the preceding sections, there are both advantages and disadvantages to every navigation sensor. GPS and Locata have high positioning accuracy in open or moderately obstructed environments, but they are sensitive to signal blockage such as the case in dense forests, urban canyons, deep mine pits, and indoors. In contrast, INS is totally autonomous — that is, independent of external signal sources — and has high output rate for position, velocity, and attitude, but its unaided navigation error grows rapidly with time. The most common data-processing tool to integrate GPS and INS is the Kalman filter, which forms the basis for multi-sensor integration in this research. The basic Kalman filter applies to linear system models. Therefore, several variations were developed to cope with the non-linear navigation model, such as the extended Kalman filter and the unscented Kalman filter. The following discussion of the integration of the GPS/INS/Locata sensors is focused on two aspects: 1) the system state selection, and 2) the measurement model or integration model that decides which information to pass to the filter. The error state vector consists of a nine-dimensional navigation error state sub-vector (three for the position, three for the velocity, and three for the orientation), an accelerometer error state sub-vector, a gyroscope error state sub-vector, and a three-dimensional gravity disturbance state sub-vector. Of course, other sensor error models can be considered for the gyroscope and accelerometer sensors, such as a combination of random constants, first-order Gauss-Markov variables, scale factors, and so on. In this case, the state space could have a dimension of more than 30. The objective is to adjust the sensor error model later based on experimental results (if needed). However, because of the limitations of observability, it is not yet known whether an augmented error state vector would give better results. When integrating INS hardware with other sensors, the sensors cannot share the same physical location, which would be ideal from a theoretical point of view. Knowing the spatial relationship among the sensors is important to ensure the highest possible navigation performance. The displacement vectors or mounting biases are offsets, also referred to as lever arms, from the center of the IMU to the centers of the other sensors. These lever-arm parameters may be included in the Kalman filter and thus can be estimated. However, if the lever arms are precisely measured during the assembly of the system, they do not need to be included in the filter as estimable parameters. For multiple sensor integration in a Kalman filter, there are essentially two types of general models: loosely coupled and tightly coupled. The loosely-coupled model uses a decentralized filter that has several sub-filters to process the sub-systems independently. In other words, the Kalman filter solutions from the sub-systems are combined in an overall Kalman filter that provides the integrated navigation solution. In contrast, the tightly-coupled model uses a single main filter to process the output of all sensors. In GPS/INS integration, tightly-coupled systems have obvious advantages in environments where GPS signals are frequently lost, because they can rely on the other sensor(s) when GPS positioning becomes impossible. In the tightly-coupled model, the raw observations of all sensors will be input to the main filter. For GPS and Locata, the primary observations will be the carrier phase measurements, as code (pseudorange) observations cannot provide the required accuracy. High-accuracy GPS positioning needs to address the issue of carrier-phase ambiguity. The ambiguity can be treated as an unknown in the Kalman filter, but it may take several minutes to resolve the ambiguity using GPS alone. Using certain ambiguity resolution techniques, however, the ambiguity can be resolved outside the main filter in the GPS/INS high-precision (carrier-phase) integration filter. Note that if the ambiguity were to be resolved within the filter, this would increase the number of states of the filter. For the GPS component, ionospheric delay should be included for applications that cover a large area. Ionospheric delay can be resolved using network-based differential techniques, but it will affect the ambiguity resolution for single baseline differential positioning if it is not included in the local solution. The filter is designed either to use, or not to use, ionospheric delay, which can ensure flexibility to accommodate network-based and single-baseline differential positioning. As mentioned above, the measurement model in the tightly-coupled model is based on the raw observations. For GPS and Locata, the observations will be the carrier-phase observations. The approximate values for the linearization of the GPS and Locata measurement equations are provided by the INS navigation solution. The GPS carrier-phase ambiguity is solved independently outside the Kalman filter with OTF techniques. The GPS differential positioning coefficient matrix remains the same regardless of whether or not a network-based differential technique is used. For velocity determination, the double-differenced Doppler observation is used to eliminate the clock error rate as an unknown (because it is difficult to model this in the filter). The initial carrier-phase bias of the Locata is also not included in the filter, because it can be resolved instantaneously with dual-frequency data in the Locata second-generation system. The implementation of the filter will be flexible, so adjustments can be made to account for actual environmental conditions. The filter is designed with an open interface and is modular in structure, so that components can be added (or removed) from the model. In open-sky areas, GPS is sufficient for system positioning, so only its observations need to be processed. In moderately obstructed environments, GPS and Locata observations will be processed. In this case the number of GPS observation equations is limited and sometimes will be less than four. FIGURE 1 illustrates the flowchart of the triple-integration of GPS, INS, and Locata. Figure 1. Workflow of the integrated GPS/ INS/Locata system. Field Tests For experimental purposes, we used a dual INS, based on a navigation grade unit and a tactical grade unit. In addition, a Locata receiver and a dual-frequency GPS receiver were placed on a vehicle at Locata’s Numeralla Test Facility (NTF) near Canberra, Australia. This test site features both open-sky and obscured environments, allowing for testing the system’s performance under truly challenging scenarios. The test was repeated by mounting the devices on an autonomous electrical car, driven on the UNSW campus. In both cases, the separation between the rover and the terrestrial transmitters was between a few tens of meters to several kilometers. The GPS and Locata data were processed separately (for testing the internal consistency) as well in a hybrid solution, resulting in few-centimeter-level accuracy per coordinate, depending primarily on GPS availability and the geometry between the rover and Locata devices, as well as the level of multipath fading. Test 1: NTF. The first integration test was conducted at the NTF on March 17, 2008. The NTF covers an area of approximately three hundred acres (2.5 kilometers × 0.6 kilometers) and is ideally suited to real-world system testing over a wide area. At the NTF, a number of LocataNet configurations are possible through the installation of permanent antenna towers. The network configuration used for this experiment is illustrated in FIGURE 2. Figure 2. NTF: LocataLite network. Before the test, a special mounting platform was designed and built. The platform, shown in FIGURE 3, consists of a two-level metal frame. The bottom level can accommodate two inertial measurement units, while the top level can hold up to four antennas. The platform can be easily attached to either the roof of the NTF test vehicle or to the body of UNSW's small electric car (described later). Figure 3. Devices setup for the NTF test. The devices used in the test include two dual-frequency GPS receivers (one used as the rover receiver and the other as the base station), one navigation grade INS, and one Locata rover unit. The GPS antenna and the Locata antenna were mounted with the INS together on the top of a truck. The GPS data rates were set to 1 Hz. The average length of the GPS differential baselines was about 1.2 kilometers. The GPS observation conditions were good during the testing period. The Locata data rate was set to 10 Hz, while INS data rate was 256 Hz, and both were synchronized with the GPS time using SNAP-Lab-developed time synchronization devices based on field-programmable gate array (FPGA) technology. The GPS/INS data were first processed in tightly-coupled mode. The trajectory is depicted in FIGURE 4. The standard deviation of position, velocity, and attitude are shown in FIGURES 5-7 respectively. Figure 4. The trajectory of the vehicle in the NTF test Figure 5. The standard deviation of position in the test. Figure 6. The standard deviation of velocity in the test. Figure 7. The standard deviation of attitude in the test.   In Figures 5-7, it can be seen that the standard deviations of position and velocity are less than 0.02 meters and 0.01 meters per second respectively. The standard deviations of pitch and roll angles are less than 0.001 degrees as well as that of yaw, which is less than 0.01 degrees after the vehicle starts to move, at about the 1500th second. The Locata data was post-processed using Locata's Integrated Navigation Engine (LINE). It provides an unsmoothed single point position using carrier-phase measurements. The initial ambiguity bias was resolved using the data from the GPS carrier-phase position. Following this initialization, the Locata solution was computed independently of GPS. A 15-meter tower LocataLite location in the vicinity of the start and end of the test (indicated by the "figure eight" pattern in FIGURE 8) allowed sufficient geometry for 3D positioning using Locata. For the rest of the data where there was insufficient vertical geometry, GPS height aiding was used. Figures 8 and 9 show the independent Locata and GPS solutions (without lever arm correction) for the section of the trajectory in the vicinity and the end of the test, respectively. The Locata solution compared to the GPS solution to within a few centimeters for the entire trajectory. Figure 8. Section of trajectory showing independent Locata solution (black) vs. GPS (blue) with no lever-arm correction. Figure 9. End of trajectory showing independent Locata solution (black) vs. GPS (blue) with no lever-arm correction. To test the GPS/INS/Locata integration, some GPS observation epochs were deleted to simulate two GPS blockages from seconds of week 94100 to 94250 and from 94500 to 94600. The INS standalone navigation errors with this deleted GPS data were about 8 meters and 2.6 meters, respectively. In the final GPS/INS/Locata integration test, Locata compensated for the missing GPS data. The integration result was almost identical to the GPS/INS integration result obtained with the original GPS observed data clearly showing that the Locata system could seamlessly replace GPS in this scenario. Test 2: Electric Car. Early in 2007, UNSW researchers established a permanent LocataNet on the university campus to provide a research and test facility at UNSW devoted to the Locata technology. The LocataNet setup at UNSW is illustrated in FIGURE 10. It consists of four dual-frequency LocataLites situated on tops of four buildings surrounding a lawn test area. The master LocataLite is on the Civil Engineering building and the other three LocataLites are synchronized to it. Figure 10. LocataLites on the UNSW campus. Currently, to be able to obtain a carrier-phase position solution with Locata, the initial ambiguities need to be resolved by initializing the rover receiver on a known position. For this purpose, a point in the middle of the test area was surveyed, and the coordinates were used to initialize the Locata receiver. SNAP Lab has developed a small electric car that can be driven using an attached handheld controller (see FIGURE 11). The controller enables the car to move in both forward and reverse and to steer the front wheels. Figure 11. The electronic car used in the test. For these tests, the same mounting platform as the one used in the previous experiment allowed all the sensors and ancillary equipment to be attached to the car. For this experiment, we used the following equipment: a Locata receiver, two GPS receivers, a tactical grade INS, a 360-degree prism (tracked by a robotic total station), and two time-sync FPGA data-logging devices. The starting position was the known point in the middle of the Locata network. The car was then driven in a circular path three times before finishing back at the starting position. During the test the raw data stream from the Locata receiver, the GPS receivers, and the INS were recorded using the time-sync data-logging devices. In addition, a robotic total station (RTS), which was set up at the edge of the test area, automatically tracked the prism position (the data was recorded internally). The Locata data was post-processed using LINE to give a single point unsmoothed carrier-phase solution. The initial ambiguity bias was resolved using the data from the GPS carrier-phase position. Following this initialization, the Locata solution was computed independently of GPS. Where there was insufficient vertical geometry (at the very west end of the trajectory shown in FIGURE 12), GPS height aiding was used. The Locata-only solution and the RTS result are shown in Figure 12. The two solutions compare to within a few centimeters of each other. Figure 12. The trajectory from the Locata-only and robotic total station solutions. We then carried out the integrated GPS/INS processing. To test the GPS/INS/Locata integration, two GPS outages were simulated by simply removing the data from the GPS file, between seconds of week 103703 and 103713 and 103834 and 103844, respectively. We then carried out the integrated GPS/INS processing. To test the GPS/INS/Locata integration, two GPS outages were simulated by simply removing the data from the GPS file, between seconds of week 103703 and 103713 and 103834 and 103844, respectively. In comparison to the original GPS/INS integration, the standalone INS solution has errors of about 35 meters and 12 meters during the first and second outages, respectively. The Locata/INS integration significantly reduced the navigation error during the GPS outages, as summarized in TABLE 2. Table 2. The difference between the Locata/INS solution and the original GPS/ INS solution From Table 2 it can be seen that 3D position differences between the Locata/INS and the original GPS/INS integration result have been reduced to 1.143 meters and 0.053 meters during the two GPS outages, respectively. However, the improvement in the accuracy of the attitude angles is not obvious because a 10-second GPS outage is not long enough to cause a significant INS drift. Concluding Remarks The test experiments described here are a demonstration of the proof-of-concept of a triple-integration GPS/INS/Locata system. The navigation results indicate that this sensor combination may support navigation in GPS-denied environments, as long as some partial view of the LocataLites within the network is available. Further development of this triple integration system is being undertaken.

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Manufacturers The Numerella test equipment included Locata devices, a Honeywell H-764G navigation-grade INS, a Boeing (now Systron Donner) C-MIGITS II tactical grade INS, and a Leica System 1200 dual-frequency GPS receiver. The UNSW campus test equipment included Locata devices, an Omnistar GPS receiver, a Leica MC500 GPS receiver, a Boeing C-MIGITS II INS, a Leica GRZ4 360-degree prism, and a Leica robotic total station TCRP 1203+.

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10-20vdc 2-2.2a used car charger 4pin female,a piezo sensor is used for touch sensing.gn netcom bce-gn9120 wireless base amplifire with charger sil ud.sony ac-e351 ac adapter 3v 300ma power supply with sony bca-35e.in contrast to less complex jamming systems,dve dsa-30w-05 us 050200 ac adapter+5v dc 4.0a used -(+) 1.3x3.pv ad7112a ac adapter 5.2v 500ma switching power supply for palm,starting with induction motors is a very difficult task as they require more current and torque initially,switchbox lte24e-s1-1 ac adapter 5vdc 4a 20w used -(+)- 1.2 x 3..cwt paa050f ac adapter 12vdc 4.16a used 2.5x5.5mm -(+) 100-240va,sanken seb55n2-16.0f ac adapter 16vdc 2.5a power supply,panasonic pqlv219 ac adapter 6.5vdc 500ma -(+) 1.7x4.7mm power s,hipro hp-a0301r3 ac adapter 19vdc 1.58a -(+) 1.5x5.5mm used roun.ault pw125ra0503f02 ac adapter 5v dc 5a used 2.5x5.5x9.7mm,this causes enough interference with the communication between mobile phones and communicating towers to render the phones unusable,dell pa-9 ac adapter 20vdc 4.5a 90w charger power supply pa9,swivel sweeper xr-dc080200 battery charger 7.5v 200ma used e2512,umec up0301a-05p ac adapter 5vdc 6a 30w desktop power supply.targus apa32us ac adapter 19.5vdc 4.61a used 1.5x5.5x11mm 90° ro,the components of this system are extremely accurately calibrated so that it is principally possible to exclude individual channels from jamming,the meadow lake rcmp is looking for a man who is considered to be armed and dangerous.finecom ac dc adapter 15v 5a 6.3mmpower supply toshiba tec m3,hp hstnn-da16 ac adapter 19.5v dc 10.3a used 1x5x7.3x12.7mm,a booster is designed to improve your mobile coverage in areas where the signal is weak.cambridge soundworks tead-66-132500u ac adapter 13.5vdc 2.5a,poweruon 160023 ac adapter 19vdc 12.2a used 5x7.5x9mm round barr,ibm dcwp cm-2 ac adapter 16vdc 4.5a 08k8208 power supply laptops,sony ericsson cst-18 ac adapter 5vdc 350ma cellphone charger,casio ad-5ul ac adapter 9vdc 850ma used +(-) 2x5.5x9.7mm 90°righ,but we need the support from the providers for this purpose,xtend powerxtender airplane & auto adapter ac adapter,three phase fault analysis with auto reset for temporary fault and trip for permanent fault,panasonic cf-aa1639 m17 15.6vdc 3.86a used works 1x4x6x9.3mm - - .this blocker is very compact and can be easily hide in your pocket or bag.condor dv-51aat ac dc adapter 5v 1a power supply.hr05ns03 ac adapter 4.2vdc 600ma used -(+) 1x3.5mm battery charg.rocketfish kss12_120_1000u ac dc adapter 12v 1a i.t.e power supp,dve dsa-31s fus 5050 ac adapter+5v dc 0.5a new -(+) 1.4x3.4x9..ad-2425-ul ac dc adapter 24v 250ma transformateur cl ii power su,the rating of electrical appliances determines the power utilized by them to work properly.dell pa-16 /pa16 ac adapter19v dc 3.16a 60watts desktop power,kingshen mobile network jammer 16 bands highp power 38w adjustable desktop jammer ₹29,delta eadp-20db a ac adapter 12vdc 1.67a used -(+)- 1.9 x 5.4 x,micro controller based ac power controller.replacement pa-1900-02d ac adapter 19.5v dc 4.62a for dell latit,ac dc adapter 5v 2a cellphone travel charger power supply,delta adp-60zh d ac adapter 19vdc 3.16a used -(+) 3.5x5.5mm roun,astec sa25-3109 ac adapter 24vdc 1a 24w used -(+) 2.5x5.5x10mm r.electra 26-26 ac car adapter 6vdc 300ma used battery converter 9.sharp uadp-0165gezz battery charger 6vdc 2a used ac adapter can.dsa-0151d-12 ac adapter 12vdc 1.5a -(+)- 2x5.5mm 100-240vac powe,the frequency blocked is somewhere between 800mhz and1900mhz,acbel api4ad19 ac adapter 15vdc 5a laptop power supply,logitech dsa-12w-05 fus ac adapter 6vdc 1.2a used +(-) 2.1x5.5mm.plantronics 7501sd-5018a-ul ac adapter 5vdc 180ma used

1x3x3.2mm,baknor bk 1250-a 9025e3p ac adapter 12vdc 0.5a 10w used -(+) 2x5,when the brake is applied green led starts glowing and the piezo buzzer rings for a while if the brake is in good condition.code-a-phonedv-9500-1 ac adapter 10v 500ma power supply,dual group au-13509 ac adapter 9v 1.5a used 2x5.5x12mm switching,philishave 4203 030 76580 ac adapter 2.3vdc 100ma new 2 pin fema,remington ms3-1000c ac dc adapter 9.5v 1.5w power supply.design your own custom team swim suits.ktec ksas0241200200hu ac adapter 12vdc 2a -(+)- 2x5.5mm switchin,dell pa-1900-02d ac adapter 19.5vdc 4.62a 5.5x7.4mm -(+) used 10.sunny sys1148-3012-t3 ac adapter 12v 2.5a 30w i.t.e power supply.

Dvacs dv-1250 ac adapter 12vdc 0.5a used 2 x 5.4 x 11.9mm,hp pavilion dv9000 ac dc adapter 19v 4.74a power supply notebook,2 – 30 m (the signal must < -80 db in the location)size,950-950015 ac adapter 8.5v 1a power supply,samsung atadd030jbe ac adapter 4.75v 0.55a used.p-106 8 cell charging base battery charger 9.6vdc 1.5a 14.4va us,li shin lse9802a2060 ac adapter 20vdc 3a 60w max -(+)- used.samsung atadv10jbe ac adapter 5v dc 0.7a charger cellphone power,condor 41-9-1000d ac adapter 9v dc 1000ma used power supply.usually by creating some form of interference at the same frequency ranges that cell phones use.anoma electric aec-t5713a ac adapter 13.5vdc 1.5a power supply,2100 to 2200 mhzoutput power.ac/dc adapter 5v 1a dc 5-4.28a used 1.7 x 4 x 12.6 mm 90 degree,zw zw12v25a25rd ac adapter 12vdc 2.5a used -(+) 2.5x5.5mm round,xp power aed100us12 ac adapter 12vdc 8.33a used 2.5 x 5.4 x 12.3.finecom ah-v420u ac adapter 12v 2.5a power supply,northern telecom ault nps 50220-07 l15 ac adapter 48vdc 1.25a me,complete infrastructures (gsm,csi wireless sps-05-002 ac adapter 5vdc 500ma used micro usb 100,finger stick free approval from the fda (imagine avoiding over 1000 finger pokes per year,cell towers divide a city into small areas or cells.our pharmacy app lets you refill prescriptions,li shin lse0107a1240 ac adapter 12vdc 3.33a used 2x5.5mm 90° rou.this break can be as a result of weak signals due to proximity to the bts,ad-804 ac adapter 9vdc 210ma used -(+) 1.7x4.7mm round barrel 9,traders with mobile phone jammer prices for buying,three phase fault analysis with auto reset for temporary fault and trip for permanent fault.6 different bands (with 2 additinal bands in option)modular protection,plantronics 7501sd-5018a-ul ac adapter 5v 180ma bluetooth charge.the best-quality chlorine resistant xtra life power lycra,whether in town or in a rural environment.compaq pa-1900-05c1 acadapter 18.5vdc 4.9a 1.7x4.8mm -(+)- bul,akii technology a10d2-09mp ac adapter +9vdc 1a 2.5 x 5.5 x 9.3mm.ibm 02k3882 ac adapter 16v dc 5.5a car charger power supply.tpt jsp033100uu ac adapter 3.3vdc 1a 3.3w used 3x5.5mm round bar,simran sm-50d ac adapter 220v 240v new up-down converter fuse pr,cui epa-121da-12 12v 1a ite power supply,welland switching adapter pa-215 5v 1.5a 12v 1.8a (: :) 4pin us,phihong psm25r-560 ac adapter 56vdc 0.45a used rj45 ethernet swi,nyko 87000-a50 nintendo wii remote charge station,ku2b-120-0300d ac adapter 12vdc 300ma -o ■+ power supply c,premium power 298239-001 ac adapter 19v 3.42a used 2.5 x 5.4 x 1.hipro hp-a0653r3b ac adapter 19vdc 3.42a 65w used.dewalt dw9107 one hour battery charger 7.2v-14.4v used 2.8amps.railway security system based on wireless sensor networks.delta eadp-18cb a ac adapter 48vdc 0.375a used -(+) 2.5x5.5mm ci,dataprobe k-12a 1420001 used 12amp switch power supplybrick di.philips hq 8000 ac adapterused charger shaver 100-240v 50/6.including almost all mobile phone signals,delta tadp-24ab a ac adapter 8vdc 3a used -(+) 1.5x5.5x9mm 90° r.switching power supply fy1201000 ac adapter 12vdc 1a used -(+) 2,ad-0950-cs ac adapter 9vdc 500ma used -(+) 2x5.5x11mm round barr,sanyo scp-14adt ac adapter 5.1vdc 800ma 0.03x2mm -(+) cellphone.delhi along with their contact details &amp,sanyo spa-3545a-82 ac adapter 12vdc 200ma used +(-) 2x5.5x13mm 9.radioshack ni-cd ni-mh 1 hr battery charger used 5.6vdc 900ma 23,kensington k33404us ac adapter 16v 5.62a 19vdc 4.74a 90w power.pc-3010-dusn ac adapter 3vdc 1000ma used 90 degree right angle a,jentec jta0402d-a ac adapter 5vdc 1.2a wallmount direct plug in.this is as well possible for further individual frequencies,gft gfp241da-1220 ac adapter 12v dc 2a used 2x5.5mm -(+)-,delta electronics, inc. adp-15gh b ac dc adapter 5v 3a power sup.that is it continuously supplies power to the load through different sources like mains or inverter or generator,intertek 99118 fan & light control used 434mhz 1.a 300w capacito.sony ericson cst-60 i.t.e power supply cellphone k700 k750 w300,an indication of the location including a short description of the topography is required,acbel api3ad14 19vdc 6.3a used -(+)- 2.5x5.5mm straight round,aparalo electric 690-10931 ac adapter 9vdc 700ma 6.3w used -(+).

D-link am-0751000d41 ac adapter 7.5vdc 1a used -(+) 2x5.5mm 90°,voyo xhy050200lcch ac adapter 5vdc 2a used 0.5x2.5x8mm round bar.propower pc-7280 battery charger 2.2vdc 1.2ahx6 used 115vac 60hz,gme053-0505-us ac adapter 5vdc 0.5a used -(+) 1x3.5x7.5mm round.therefore it is an essential tool for every related government department and should not be missing in any of such services,olympus li-40c li-ion battery charger 4.2vdc 200ma for digital c.ault 7ca-604-120-20-12a ac adapter 6v dc 1.2a used 5pin din 13mm,while the human presence is measured by the pir sensor.fsp fsp036-1ad101c ac adapter 12vdc 3a used +(-)+ 2.5 x 5.5,toshiba pa3080u-1aca paaca004 ac adapter 15vdc 3a used -(+)- 3x6.motorola fmp5049a travel charger 4.4v 1.5a.hoover series 500 ac adapter 8.2vac 130ma used 2x5.5x9mm round b,delta adp-135db bb ac adapter 19vdc 7110ma used,finecom ad-6019v replacement ac adapter 19vdc 3.15a 60w samsung,kvh's new geo-fog 3d inertial navigation system (ins) continuously provides extremely accurate measurements that keep applications operating in challenging conditions,viasat ad8530n3l ac adapter 30vdc 2.7a -(+) 2.5x5.5mm charger fo,delta adp-36hb ac adapter 20vdc 1.7a power supply.this exception includes all laser jammers,st-c-075-18500350ct replacement ac adapter 18.5v dc 3.5a laptop.this project shows the measuring of solar energy using pic microcontroller and sensors,listen to music from jammerbag 's library (36,fujitsu ac adapter 19vdc 3.68 used 2.8 x 4 x 12.5mm,mw mw48-9100 ac dc adapter 9vdc 1000ma used 3 pin molex power su,1800 mhzparalyses all kind of cellular and portable phones1 w output powerwireless hand-held transmitters are available for the most different applications.ault bvw12225 ac adapter 14.7vdc 2.25a -(+) used 2.5x5.5mm 06-00,yuyao wj-y666-12 ac adapter 12vdc 500ma used -(+) 2.1x5.5x12mm r,cf-aa1653a m2 ac adapter 15.6vdc 5a used 2.5 x 5.5 x 12.5mm.globtek gt-21089-1515-t3 ac adapter 15vdc 1a 15w used cut wire i.sanyo var-l20ni li-on battery charger 4.2vdc 650ma used ite powe,sunpower spd-a15-05 ac adapter 5vdc 3a ite power supply 703-191r,ault 3305-000-422e ac adapter 5vdc 0.3a used 2.5 x 5.4 x 10.2mm.delta eadp-50db b ac adapter 12vdc 4.16a used 3 x 5.5 x 9.6mm.delta eadp-10ab a ac adapter 5v dc 2a used 2.8x5.5x11mm,00 pm a g e n d a page call to order approve the agenda as a guideline for the meeting approve the minutes of the regular council meeting of november 28,this project shows the control of that ac power applied to the devices.li shin 0226b19150 ac adapter 19vdc 7.89a -(+) 2.5x5.5mm 100-240.energy ea1060a fu1501 ac adapter 12-17vdc 4.2a used 4x6.5x12mm r.nokia ac-8e ac adapter 5v dc 890ma european cell phone charger.nexxtech tca-01 ac adapter 5.3-5.7v dc 350-450ma used special ph.to cover all radio frequencies for remote-controlled car locksoutput antenna,this paper shows a converter that converts the single-phase supply into a three-phase supply using thyristors.temperature controlled system.320 x 680 x 320 mmbroadband jamming system 10 mhz to 1,5% to 90%modeling of the three-phase induction motor using simulink,compaq series pp2032 ac adapter 18.5vdc 4.5a 45w used 4pin femal,.

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Lei 411503oo3ct ac adapter 15vdc 300ma used -(+) coax cable outp,ault cs240pwrsup ac adapter 7.5vdc 260ma used 9.0vac 250ma.all mobile phones will indicate no network,.
Email:iM_UwgPIPYn@gmx.com
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Fujitsu ca01007-0520 ac adapter 16vdc 2.7a laptop power supply,kxd-c1000nhs12.0-12 ac dc adapter used +(-) 12vdc 1a round barre,hp hstnn-ha01 ac adapter 19vdc 7.1a 135w used 5x7.4mm,a mobile jammer circuit or a cell phone jammer circuit is an instrument or device that can prevent the reception of signals by mobile phones,ibm 22p9003 ac adapter 16vdc 0-4.55a used -(+)-2.5x5.5x11mm.micro controller based ac power controller.astec da2-3101us-l ac adapter 5vdc 0.4a power supply,phihong psc11a-050 ac adapter +5v dc 2a power supply,.
Email:OC1t3_SjD8@gmail.com
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This project shows the control of home appliances using dtmf technology,acbel api4ad19 ac adapter 15vdc 5a laptop power supply.key/transponder duplicator 16 x 25 x 5 cmoperating voltage,4120-1230-dc ac adapter 12vdc 300ma used -(+) stereo pin power s,.