DOWNLOAD PDF LOCATION, NAVIGATION, AND CONTROL SYSTEMS

Chapter 1 : Global Positioning System - Wikipedia

Guidance, navigation and control (abbreviated GNC, GN&C, or G&C) is a branch of engineering dealing with the design of systems to control the movement of vehicles, especially, automobiles, ships, aircraft, and spacecraft.

I am filling in for Professor Hoffman who is off addressing the French Parliament at this moment, or maybe it was yesterday afternoon. Tough choices of whether to stay here or go there. These days the issue of knowing where you are, navigation is really taken for granted. We have GPS in our cell phones. GPS in handheld devices. GPS tells the taxi driver whether or not he should be turning up that one way street. When we began with human space travel, particularly as we entered the Apollo era, the question of navigation, along with guidance and control, was still a major issue. In fact, it was rather uncertain whether or not, in the Apollo mission, we were going to be able to, with assurance, do all of the navigation required for going to lunar trajectory and then doing the precise navigation to land on the moon. The history of leading guidance navigation and control has now, for a period of over half a century, been located just adjacent to, at one time part of MIT, the Instrumentation Laboratory, now Draper Laboratory. And the tradition carried on through Apollo to the Space Shuttle Program. He is a member of the Laboratory Technical Staff, which is the highest technical position available there. Phil has been very active in AIAA. He is a fellow. He has been head of the New England region. Thanks a lot, Larry. I should just point out, when I came up here as a graduate student to pursue my doctorate, I was a Draper fellow. I started working on the Shuttle as a Draper fellow, so much of the work I will be talking about here, I was probably only a year or two older than any of you when I was doing this. Now, the other thing they could have asked me for was the report on which this material was based, which I wrote in to educate the rest of the people at Draper who were going to work on the program subsequently about this system. Now, the other thing I just want to say is feel free to interrupt me at any point to ask questions. So just raise your hand or speak up or whatever you feel like. And the other things I want to point out are two things. Now, I am not going to be comprehensively covering all the upgrades that have been done to the Shuttle since. What you will also note is this presentation will be largely monochrome. Because it is drawn from a presentation of when there was no such thing as a laptop or PowerPoint and color was a real pain to get. You had to go to the artist and then get it lithographically reproduced which was an incredibly cost. I do have some before and after cockpit pictures at the end. There are going to be a whole bunch of sub-bullets for each of these areas as I go through. This will be not real deep, unless you ask me the questions and I will go as deep as you want with the questions but covering a lot of ground. Some of these pictures you may have seen in one form or another, but I should just highlight certain points. The systems related to the flight control were placed all over the Shuttle. In the forward area, which was the only pressurized portion of the Shuttle, below the livable areas was the avionics bay. And, in there where the computers, the inertial measurement unit, and I want to say something about that in a moment, what they refer to as multiplexers-demultiplexers. And the electronic boxes that drove the commands for the reaction control system thrusters. And then you have hand controllers and displays and indicators in the cockpit. In the back you have pods which have many of the reaction control system jets, the orbital maneuvering system thrusters. And I will be talking quite a bit more about them later. And there was also in the aft avionics bay that had specific subsystems for which it was deemed unacceptable to have them forward. Some of them were local analog digital conversion boxes, but also rate gyros which were used during assent and entry where they wanted them closer to the center of mass by being in the back and in the front avoiding some of the flexure issues associated with the long distance to the front. This configuration is where the story begins because what I am going to be talking about is the part that Draper did which is the exoatmospheric flight control system. And that begins at main engine shutdown and ends when you hit , feet on the way back. There are different phases that we will be talking about. The first is what we refer to as insertion which is from the time the main engines cut off to the time you do initial orbit circularization. It includes the separation maneuver from that. And, in the original flight profile for the Shuttle two burns of the orbital maneuvering system, the original orbit insertion strategy for the Shuttle put it in an orbit that typically had an apogee of about 60 nautical miles, a perigee of just a few nautical miles. What you would do is the first burn would raise that perigee up to the plus nautical mile target altitude and then the second burn halfway around the earth would put you into a circular orbit and then you would begin your mission there. Later in the program for overall efficiency, in order to improve the payload margins, that strategy changed. And they tended to do more what they call direct insertion which had a substantial higher apogee. And then you would do one OMS burn and you would get a net gain of maybe one or two thousand pounds which became very important. During this insertion phase all the applicable sensors were on. You get these combined packages called inertial navigation systems now. They do all the processing for you. They even have built in GPS receivers. The inertial measurement unit was a pretty clunky gimbaled device at the time the Shuttle first flew. It subsequently got upgraded to ring laser gyro systems. But that inertial measurement unit was simply outputting angles that were significant throughput issues. Because you had to do a lot of data crunching to get rates from that. Computers are really slow. I will talk a little bit more about that in a few minutes. Having rate gyros separate was a way to get data that these days would be all built into one box. General purpose computers, all of them were on during ascent. I will talk about the partisan of them, but there were actually five of them. And the Vernier reaction control system, which is a small group of jets, and I will point those out later, were not active. The larger thrusters were. And then, after the second OMS burn, you transition to another flight phase. And why all these flight phases, I will get to in a couple minutes also. Then orbit phase began after the second burn. You quickly open the doors so that you could dump waste heat. The radiators are on the inside of the doors. And, when the doors are closed, the heat just radiates back into the vehicle. All payload operations are during this phase. And you did a lot of power down to save. It limits your mission life both because of the limits on the weight of the reactants and on the places you can put any extra tanks. Two of the five general purpose computers were shut down. That was actually an improvement from the approach and landing test when it was 64, words. And then you turned off two of the three redundant inertial measurement units, except for critical phases. Also the safe power, the feeling was that if you lost your navigation reference you would have a relatively benign environment to bring one of the others up. And the Vernier thrusters were made available because they were used for flying control. Then you have the deorbit phase. You close the doors again. You do the deorbit burn. You dump any residual propellant from the forward tanks by simultaneously burning opposing thrusters in order to get an acceptable center of mass for entry. Getting the acceptable location of the center of mass for attitude and thermal control during entry is very critical. You reactive all the sensors. You go back to all the computers being up. And that is where the entry phase takes over. And this is just a summary of the profile. Now, this is where I wanted to take the opportunity to talk a little bit about computers and profiles and everything else. When we started this program with a 64, word computer, I talk in terms of words instead of bytes. You had words and half words. Each word was equivalent to about four bytes in terms of number of characters you could insert into it. But you only could break it down into pieces of two. So we had , - well, a thousand times 24 pieces of memory that we could work with on this computer. For the approach and landing test, which was very limited, you flew it off of a for a couple of minutes, 64, words worked just fine. They upped it to , words. So the solution, in addition to descoping as much as possible, what you had to have was to separate the computer loads that you had for up and down which you did when you were doing your orbital mission. And then you had something called the mass memory device which is basically a tape drive which when you went from this phase to this phase would reload some of the computers. And I said there were five of these computers. Quad redundant so that they would vote all data going in and out to decide whether or not there was an inconsistency between one computer and the other. And it would automatically deselect the bad computer, the implications of which I will talk about probably about three-quarters of the way through the presentation.

Chapter 2 : GSM and GPS Embedded Live Projects for Engineering Students

guidance, navigation and control Guidance, navigation and control software command the GN&C system to effect vehicle control and to provide the sensor and controller data needed to compute these commands.

By , ten more experimental Block-I satellites had been launched to validate the concept. On May 2, "Selective Availability" was discontinued as a result of the executive order, allowing civilian users to receive a non-degraded signal globally. Bush updated the national policy and replaced the executive board with the National Executive Committee for Space-Based Positioning, Navigation, and Timing. Bradford Parkinson , professor of aeronautics and astronautics at Stanford University , conceived the present satellite-based system in the early s and developed it in conjunction with the U. Parkinson served twenty-one years in the Air Force, from to , and retired with the rank of colonel. GPS developer Roger L. Easton received the National Medal of Technology on February 13, The IAF Honors and Awards Committee recognized the uniqueness of the GPS program and the exemplary role it has played in building international collaboration for the benefit of humanity. Basic concept of GPS[edit] This section needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. The satellites carry very stable atomic clocks that are synchronized with one another and with the ground clocks. Any drift from true time maintained on the ground is corrected daily. In the same manner, the satellite locations are known with great precision. GPS receivers have clocks as well, but they are less stable and less precise. GPS satellites continuously transmit data about their current time and position. A GPS receiver monitors multiple satellites and solves equations to determine the precise position of the receiver and its deviation from true time. At a minimum, four satellites must be in view of the receiver for it to compute four unknown quantities three position coordinates and clock deviation from satellite time. More detailed description[edit] Each GPS satellite continually broadcasts a signal carrier wave with modulation that includes: A pseudorandom code sequence of ones and zeros that is known to the receiver. By time-aligning a receiver-generated version and the receiver-measured version of the code, the time of arrival TOA of a defined point in the code sequence, called an epoch, can be found in the receiver clock time scale A message that includes the time of transmission TOT of the code epoch in GPS time scale and the satellite position at that time Conceptually, the receiver measures the TOAs according to its own clock of four satellite signals. From the TOAs and the TOTs, the receiver forms four time of flight TOF values, which are given the speed of light approximately equivalent to receiver-satellite ranges. The receiver then computes its three-dimensional position and clock deviation from the four TOFs. The height may then be further converted to height relative to the geoid e. These coordinates may be displayed, e. User-satellite geometry[edit] Although usually not formed explicitly in the receiver processing, the conceptual time differences of arrival TDOAs define the measurement geometry. The line connecting the two satellites involved and its extensions forms the axis of the hyperboloid. The receiver is located at the point where three hyperboloids intersect. While simpler to visualize, this is the case only if the receiver has a clock synchronized with the satellite clocks i. There are marked performance benefits to the user carrying a clock synchronized with the satellites. Foremost is that only three satellites are needed to compute a position solution. If it were an essential part of the GPS concept that all users needed to carry a synchronized clock, a smaller number of satellites could be deployed, but the cost and complexity of the user equipment would increase. Receiver in continuous operation[edit] The description above is representative of a receiver start-up situation. Most receivers have a track algorithm , sometimes called a tracker, that combines sets of satellite measurements collected at different timesâ€"in effect, taking advantage of the fact that successive receiver positions are usually close to each other. After a set of measurements are processed, the tracker predicts the receiver location corresponding to the next set of satellite measurements. When the new measurements are collected, the receiver uses a weighting scheme to combine the new measurements with the tracker prediction. In general, a tracker can a improve receiver position and time accuracy, b reject bad measurements, and c estimate receiver speed and direction. The disadvantage of a tracker is that changes in speed or direction can be computed only with a delay, and that derived direction becomes inaccurate when the distance traveled between two position measurements drops below or near the random error of position measurement. GPS units can use measurements of the Doppler shift of the signals received to compute velocity accurately. In typical GPS operation as a navigator, four or more satellites must be visible to obtain an accurate result. Applications for GPS such as time transfer , traffic signal timing, and synchronization of cell phone base stations , make use of this cheap and highly accurate timing. Some GPS applications use this time for display, or, other than for the basic position calculations, do not use it at all. Although four satellites are required for normal operation, fewer apply in special cases. If one variable is already known, a receiver can determine its position using only three satellites. For example, a ship or aircraft may have known elevation. Some GPS receivers may use additional clues or assumptions such as reusing the last known altitude , dead reckoning , inertial navigation , or including information from the vehicle computer, to give a possibly degraded position when fewer than four satellites are visible. March Learn how and when to remove this template message The current GPS consists of three major segments. These are the space segment, a control segment, and a user segment. Air Force develops, maintains, and operates the space and control segments. GPS satellites broadcast signals from space, and each GPS receiver uses these signals to calculate its three-dimensional location latitude, longitude, and altitude and the current time.

Chapter 3 : theinnatdunvilla.comon Property (theinnatdunvilla.com) | Microsoft Docs

Guidance, Navigation, and Control Systems The capabilities of the ASI Guidance, Navigation and Control (GN&C) group include all phases of spacecraft and GN&C subsystem development from conceptual design through in-space operations.

Easy to find the stolen Car. Global Positioning System GPS has been used in various commercial applications including transportation, navigation and vehicle position tracking, which when coupled with GSM mobile phone technology, the technology can help locate stolen vehicle and retrieval process. This Project can be used to control up to 16 electrical devices. The purpose of this circuit is to make the human life better and easier. Android based realtime lamp dimmer over bluetooth. The purpose of this project is to measure the temperature using LM35 sensor. This temperature is processed by microcontroller and sent to the user over GSM mobile. Construction of Smart mobile phone with driving mode selection to avoid accidents. GPS navigator for blind with speech recognition and voice enabled turn-by-turn guidance. GPRS based realtime data logger onto live website www. Useful for Electricity Department personal for remote meter reading. Also useful to disconnect the power supply to consumer incase of non-payment of electric bill. This is also used to exchange messages like power cut timings with the consumers. Microcontroller and GPS based geographical map drawing instrument. Very useful for Civil engineers. Microcontroller and voice based alerting system for blind people with GPS enabled location identification. This system records the travel path and location with timings. Also records the destination of each employee home. Construction of central control unit for Irrigation water pumps. Cost effective method to control entire villagers water pumps with user level authentication. Build your own voice operated mobile phone. GPS and Graphical display based tourist-guiding system with Touchscreen keyboard input for dynamic location recording. This can be used any where in the world including Sea and Forest locations. Mobile phone controlled four-legged walking robot with speed and direction control. Human travel location tracking system by using GPS. Smartphone Android Operated Robot. Android phone Accelerometer sensor based Robot Navigator. DTMF mobile phone controlled dam water gates controlling system with high-level protection. Remote control of critical software applications with mobile phone. Geo localised automatic traffic density alert system. This system continuously monitors the traffic density and sends SMS alerts to the vehicles near to the traffic junction. Android mobile phone operated home automation. GSM based Highway vehicle traffic monitoring system. A smart GSM based embedded solution for continuous remote monitoring of cardiac patients. GSM based student data acquisition. Home appliances monitoring and controlling system using GSM with fencing auto alerts. GPS based sensitive area locator. The purpose of this project is to monitor the vehicles moving on highways at remote locations. The vehicle count is logged by the microcontroller. This vehicles information is sent to the user over GSM modem. The information can be sent to the user periodically or can be sent on demand by sending a missed call or SMS. Students will be provided with following: Complete working Hardware Kit. Enquiry for the above listed Projects Please Call us for faster response email:

Chapter 4 : Control Systems / Space Engineering & Technology / Our Activities / ESA

GPS and Its Use for Vehicle Navigation and Control Systems, Lecture by Prof. David M. Bevly Les Ã©vÃ©nements de la communautÃ© PDS - Positionnement et Datation par Satellite.