Intelligent Missile Guiding Technology

[1]Mukti Kanta Dash, [2]Priyabrata Pattanaik

Abstract--- *This paper is concentrated on utilization of GPS and "Relative GPS/ATACMS Scenario". The rocket can be guided by various ways, for instance by utilizing radio waves, infrared, laser and also by utilizing GPS and INS. Radio waves are utilized when rocket is guided by a human administrator or by utilizing radar architecture. Infrared is utilized to manage the rocket when target produces heat energy. With the assistance of infrared heat energy produced by the objective which is distinguished, at that point rocket is guided by following warmth produce by the objective. Laser direction works by pointing laser on the object, at that point rocket is guided by the laser beam. Finally, the advantages and limitations of the GPS based missiles/rockets were discussed.*

Index Terms--- *GPS, ATACMS "(Precision-Guided Munitions Army's Tactical Missile System)", LASER.*

I INTRODUCTION

An increasing number of weapon system relies on the GPS in order to provide accurate on-board calibration of INS. The path generating system achieves high precision for ground and "Naval Surface Fire Support" mission to reduce the fly-out error of weapons. The GPS route refreshes grant exact handover from midcourse stage to the terminal direction stage by decreasing heading mistakes and arrangement mistakes in the route architecture[1], [2]. Decrease in arrangement errors permits the guidance systems with limited diversion to steer out delivery faults before interception. Decrease in the arrangement errors allows an early target achievement by the narrow beam without the necessity of elongated search pattern. The "Precision-Guided-munition" is intended to hit a specific target and minimize the overall damage. As the damage caused by the explosive weapons decrease along with the implementation of distance that follows an inverse cubes law, latest improvement in accuracy enables the target to be hit by lesser attackers[3], [4]. This paper will analyse the utilization of GPS/INS to guided weapon architecture and depict the structural usage and required degrees of architecture displaying to review the models.

Missile guiding technology concerns the technique by which the missile gets its directions to move along a specific way to arrive at a specific target[3], [5]–[7]. On certain rockets, these directions are produced inside by the rocket PC autopilot. The rocket sensor or searcher, then again, is a part inside a rocket that produces information nourished into the rocket PC. This information is prepared by the PC and used to produce direction. Sensor types generally utilized today incorporate infrared, radar, and the worldwide situating architecture. In light of the relative situation between the

Department of Electronics and Communication Engineering, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, muktikantadash@soa.ac.in, priyabratapattanaik@soa.ac.in

Received: September 2019 | Revised: October 2019 | Accepted: November 2019

rocket and the objective at some random point in flight, the PC autopilot sends directions to the control surfaces to change the rocket's course.

I.I. Missile Guiding Types:

Large early guiding missiles were based on gyroscopic models that used gyroscope in order to increase the reactivity of the navigation system. Missiles were guided to acquire their targets using:

- RADAR signal
- Wires
- LASERs
- GPS.

I.I.I. RADAR signal for guiding missile:

Guided missiles use radar signatures to obtain their targets are designed to house in on with the unique signature. As soon as the missile gets launched, it uses its on-board navigation system to reach the pre-programmed radar signature[8]–[10]. Most radar-guided missiles acquire their targets very effectively, but these missiles need a source to pump out the radar signals so they can achieve their target. On today's battlefield, the main problem with these missiles is that the countermeasures used against these missiles work on the same principles under which these missiles run.

I.I.II. Wires for guiding missile:

Upon launching of the missile, it proceeds from the launch vehicle in a linear direction. In the tail section of the missile, miles of small, fine wire are wounded and unwind as the missile travels to the target[11], [12]. The gunner sends navigational signals along this wire to guide the missile to the target. If the wire breaks for some reason, the target will never be achieved by the missile. Wire-guided missiles do not carry an array of instruments to allow them to acquire a target. The fact that area from which the missile is fired must stay out in the open to direct the missile to its target is a major downside to wired guided missiles.

I.I.III. Guiding missile through lasers:

Laser-guided missiles” reach their target using a laser of a certain frequency range. The gunner uses a laser to view the target; this is called target painting. When the missile is launched, it searches for heat signature created by the laser on the target using its on-board instrumentation. Once the missile finds the heat signature, the target is achieved, and even if the target is moving, the missile will return back with the target [13]. Not with-standing the success of laser-guided missiles, these weapons are not good when there is adequate cloud cover in the rain or weather conditions.

I.I.IV. Guiding missile through GPS:

Differential correction technique leads to accuracy within a certain range with advancement in equipment. It requires a base station, a receiver and a data collector placed on a stationary position basically on a known point. As the location of the base station is identified, computation of correction factor is performed by comparing the located

Received: September 2019 | Revised: October 2019 | Accepted: November 2019

position with location of the GPS that can be determined using satellites. The corrected data is applied to GPS data collected by GPS receiver.

II GUIDING MISSILE USING SATELLITES

The technology behind guiding the missile using DGPS/GPS uses “3-axis gyro/accelerometer” used to correct the drift error that is accumulated in the package using “GPS PPS/P-code. The next increment is updating the weapon before launching with a DGPS based location estimate that will enable it to rectify its GPS error as it reaches the target, these weapons are known as "precise" and provide more precision than laser or TV-guided weapons, likely multi-feet CEPs[14]–[16]. Developing solely GPS / inertial guided munitions would bring about significant changes in the manner in which air warfare is conducted. Unlike a gun guided by laser, a GPS / inertial weapon does not allow the launch aircraft to stay in the proximity of the target to illuminate it for guidance — GPS / inertial weapons are completely autonomous when released, and all weather capable without any deterioration in accuracy. Existing precision weapons need a clear line of sight between the gun and the target for operational optical guidance.

III SATELLITE GUIDED WEAPONS

Poor visibility has no impact on satellite-guided weapons like JDAM (Joint Direct Attack Munitions) that uses “satellite navigation systems”, particularly the GPS system. It provides enhanced sensitivity compared to laser systems and can work under all weather conditions without the need for ground support. Since GPS can be jammed, the bomb can return to inertial navigation if the GPS signal is lost. Inertial navigation is much less accurate; under GPS guidance, JDAM achieves a CEP of 13 m, but usually only 30 m under inertial guidance[17]–[19]. In fact, the CEP inertial guidance decreases as the falling altitude rises, while the GPS CEP does not. The weapons' precision depends on both the accuracy of the measurement device used to determine the location and the accuracy of the target's coordinate. Critically, the latter relies on knowledge about data, which is not at all reliable. Nevertheless, if the targeting information is accurate, satellite-guided weapons are much more likely to achieve an effective strike under any given weather than any other type of precision-guided ammunition.

Received: September 2019 | Revised: October 2019 | Accepted: November 2019

Figure 1: Guided missile

IV PROPOSED SYSTEM

The navigation system design was developed with the receiver model to reflect a general purpose INS architecture that could be tailored to a variety of specific flight hardware and software configurations[20]–[22].

There are many potential ways of inertial navigation and equations of Kalman filter system that can be implemented depending on the particular application. For the receiver model, the Earth-centred, Earth-fixed (ECEF) coordinate frame is a natural one because it is the frame in which GPS measurements are taken.

GPS is the most efficient navigation system used in military, industrial, civil and science technology miracles.

- “Navigation System Timing and Range” (NAVSTAR) GPS is now available at any time, at any setting, on or above the Earth. NAVSTAR also provides accurate time to synchronize the atomic clocks used in different military applications within a millionth of a second[23], [24].
- GPS is used to locate living and non-living objects in their present position, this term is used in the popular "GOOGLE EARTH."

Received: September 2019 | Revised: October 2019 | Accepted: November 2019

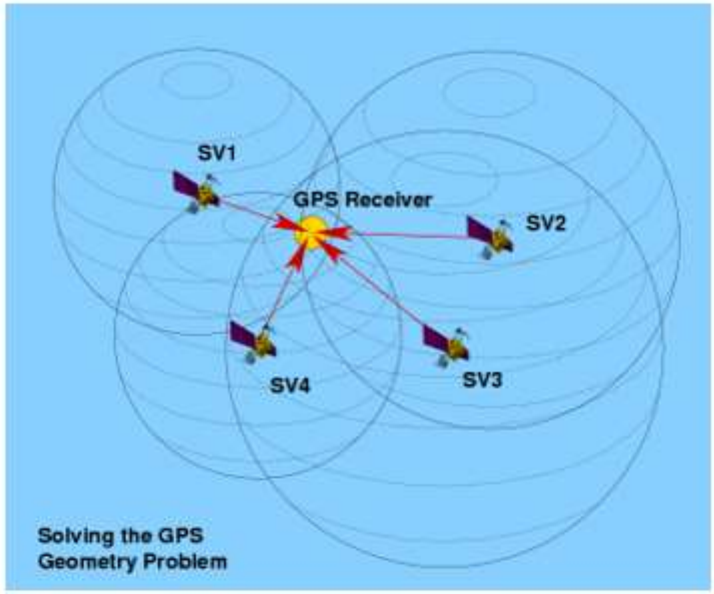

Figure 2: Missile guided using GPS

V. CONCLUSION

The escalation of GPS/INS is a sword with double edge. On one side the technology promises to revolutionize the air warfare that is not seen with the LASER guided bomb that promotes single bombers to perform multiple aircraft combinations. The weapons guided by single bombers are not affected by bad climatic conditions or are restricted by wire, nor leave the gunner prone for attack.

REFERENCES

[1] S. Y. Yang and C. L. Hsu, 'A location-based services and Google maps-based information master system for tour guiding', Comput. Electr. Eng., 2016.
[2] D. Tom-Aba et al., 'Innovative technological approach to ebola virus disease outbreak response in Nigeria using the open data kit and form hub technology', PLoS ONE. 2015.
[3] F. Pappalardi, S. J. Dunham, M. E. LeBlang, T. E. Jones, J. Bangert, and G. Kaplan, 'Alternatives to GPS', Ocean. Conf. Rec., 2001.
[4] R. Azhagumurugan, G. Vignesh Kumar, and A. Karthik, 'Guiding & control of fishermen boat using GPS', in 6th International Conference on Computation of Power, Energy, Information and Communication, ICCPEIC 2017, 2018.
[5] Y. H. Chang and B. S. Lin, 'An inquiry-based ubiquitous tour system', in Proceedings of the International Conference on Complex, Intelligent and Software Intensive Systems, CISIS 2011, 2011.
[6] B. Séroussi et al., 'Why GPs do not follow computerized guidelines: An attempt of explanation involving usability with ASTI guiding mode', in Studies in Health Technology and Informatics, 2010.
[7] A. Repenning and A. Ioannidou, 'Mobility agents: Guiding and tracking public transportation users', in Proceedings of the Workshop on Advanced Visual Interfaces, 2006.
[8] A. Al-Halhouli, H. Qitouqa, N. Malkosh, A. Shubbak, S. Al-Gharabli, and E. Hamad, 'LEGO Mindstorms NXT for elderly and visually impaired people in need: A platform', Technol. Heal. Care, 2016.
[9] H. Gawari and P. M. Bakuli, 'Voice and GPS Based Navigation System for Visually Impaired', Int. J. Eng. Trends Technol., 2014.

Received: September 2019 | Revised: October 2019 | Accepted: November 2019

[10] I. Ghazi, I. Ul Haq, M. R. Maqbool, and S. Saud, 'GPS based autonomous vehicle navigation and control system', in Proceedings of 2016 13th International Bhurban Conference on Applied Sciences and Technology, IBCAST 2016, 2016.
[11] N. Watthanawisuth, A. Tuantranont, and T. Kerdcharoen, 'Design of mobile robot for real world application in path planning using ZigBee localization', in International Conference on Control, Automation and Systems, 2014.
[12] B. F. Wu, Y. H. Chen, and P. C. Huang, 'A localization-assistance system using GPS and wireless sensor networks for pedestrian navigation', J. Converg. Inf. Technol., 2012.
[13] M. Bailly-Grandvaux et al., 'Guiding of relativistic electron beams in dense matter by laser-driven magnetostatic fields', Nat. Commun., 2018.
[14] GNSS — Global Navigation Satellite Systems. 2008.
[15] H. Croft, J. M. Chen, and T. L. Noland, 'Stand age effects on Boreal forest physiology using a long time-series of satellite data', For. Ecol. Manage., 2014.
[16] L. Combrinck, 'Satellite laser ranging', in Sciences of Geodesy - I: Advances and Future Directions, 2010.
[17] E. A. Sholarin and J. L. Awange, 'Global navigation satellite system (GNSS)', in Environmental Science and Engineering (Subseries: Environmental Science), no. 9783319276496, 2015, pp. 177–212.
[18] C. Binns, 'Global Navigation Satellite System (GNSS)', in Aircraft Systems, 2018, pp. 387–431.
[19] B. Sadoun and O. Al-Bayari, 'On the inclusion of geographic information systems (GIS) in global navigation satellite systems (GNSS)', Int. J. Commun. Syst., vol. 20, no. 3, pp. 385–396, 2007.
[20] H. Herrmann and H. Bucksch, 'satellite laser ranging', in Dictionary Geotechnical Engineering/Wörterbuch GeoTechnik, 2014, pp. 1169–1169.
[21] D. Coulot, F. Deleflie, P. Bonnefond, P. Exertier, O. Laurain, and B. de Saint-Jean, 'Satellite laser ranging', Encycl. Earth Sci. Ser., vol. Part 5, pp. 1049–1055, 2011.
[22] M. Ibrahim, Y. S. Hanna, S. W. Samwel, and M. A. Hegazy, 'Satellite Laser Ranging in Egypt', NRIAG J. Astron. Geophys., vol. 4, no. 1, pp. 123–129, 2015.
[23] M. Jaleeluddin, 'A Service-Oriented Architecture based Global Positioning System', IOSR J. Eng., vol. 02, no. 10, pp. 09–13, 2012.
[24] Department Of Defense U.S.A, 'Global Positioning System Standard Positioning Service Performance Standard', 2008.

Received: September 2019 | Revised: October 2019 | Accepted: November 2019