Jobbnorge-ID: 102609
Søknadsfrist: Avsluttet
Nettside:
Omfang:
Varighet:

PhD - GBAS system modelling

Background:

Indra Navia has been working on the development of a GBAS (Ground Based Augmentation System) ground station over the last five years, and aims at certifying the station within the next few years in order to commercialize the product well before 2020. The proposed PhD work is a key element in reaching this ambitious goal.

The GBAS project at Indra Navia consists of developing a satellite-based landing system for aircrafts called GBAS. Figure 1 illustrates the basic principle of a GBAS ground subsystem (GS) installation. The GBAS GS operates as a differential GNSS (Global Navigation Satellite System) installation broadcasting corrective signals to airplanes, that can correct the GNSS signals their GBAS avionics (the GBAS equipment installed on-board the air-plane) receive. The principle is that the aircraft navigates on navigation signals received from a GNSS, the American GPS is a well-known operating GNSS today, the European Galileo may be used in the future, and other countries have other GNSS, like Russia and China. The navigation signals from these systems are very precise, but there may be problems in the satellites, in the propagation channel, or in the system that induce errors on the order of meters. In zero visibility landing conditions (so called CAT III conditions), a few meters offset is too much. The task of a GBAS GS is to use the same satellite navigation signals as the approaching airplane, and as the GBAS GS knows its own position exactly, it should be able to detect errors. When errors are detected by the GS, correction messages will be sent to the landing aircraft over a local radio link.

The GBAS GS consists of several GNSS receivers, sending the GNSS signals to the GBAS GS rack usually installed in a shelter somewhere on the airport. The information is treated in a processing unit and sent out to a VDB (Very high frequency Data Broadcasting) transmitter antenna, from where the correction signals are sent to the airplanes. A VDB receiver in the ground subsystem will also pick up the transmitted radio signal on air and send it back to the processing unit for verification. A GBAS GS installation will also comprise one or several control units, e.g. installed in the control tower.

In principle, a GBAS GS installation does not necessarily need to be installed at an airport, but normally the siting restrictions (e.g. security requirements) will dictate so. One GBAS GS may guide air traffic for several runways, as long as the geographical locations meet the siting restrictions that apply to the individual categories of runways being served.

Figure 1. Basic GBAS architecture

Indra Navia is a world leading company on development, production and delivery of Instrument Landing Systems (ILS). These systems are installed worldwide on large and medium size airports, and enable safe landing in bad weather conditions with reduced sight. They have been operating for approximately the last 50 years, and are well proven and trusted. However, new technology is available, technology that will help mitigation of some of the challenges connected to the installation and operation of the ILS:

- The terrain in front of an ILS antenna installation must be flat over a relatively large area. In many cases this is an expensive requirement to meet, and in some cases even impossible. Especially in countries like Norway this may be a challenge.
- Traffic is not allowed in sensitive areas in front of the antennas. This implies that there must be a certain separation between landing aircrafts, which again reduces the airport capacity.
- The frequency spectrum is a rare resource, and in some congested areas, the airports are located so close geographically, that it becomes impossible to install new landing systems.
- With ILS, it is only possible to follow a linear flight path for landing. Use of satellite technology will enable new flight patterns, like curved and parallel approaches, new approach angles and several touch-down points. This may solve environmental problems connected with flight over inhabited areas that are today bothered by excessive noise, and it may also increase the airport capacity.
- ILS requires two installations at each runway end for approaching traffic, one indicating the direction, and one indicating the glide path. Hence, each runway requires four installations. One GBAS ground station can serve all runways on an airport. This reduces the need for space, it reduces cost and need for maintenance.

Indra Navia is currently developing a GBAS GS within the framework of the European ATM (Air Traffic Management) project SESAR. This development has also received a great deal of financial support from the Norwegian Space Centre, and newly also from the Norwegian Research Council.

The development is very comprehensive in areas with good signal reception conditions, and becomes even more challenging in northern regions, due to special problems connected to satellite geometry, ionospheric disturbance, harsh weather conditions and special topography. These challenges may negatively influence also the accuracy of the GBAS GS calculations. Three types of requirements are defined by ICAO (International Civil Aviation Organization); availability, continuity and integrity. Especially the last requirement on integrity is hard to meet, saying that the GBAS GS shall not sent misleading information to an approaching aircraft. This is why comprised in the development of a GBAS GS, are a large number of monitors that shall detect navigation signal errors, and guarantee to be within ICAO standardized limits for Probability of Missed Detection (PMD) and Probability of False Alarm (PFA).

These limits will vary to some extent, depending on the type of category the landing system is certified to be used for. Figure 2 shows the three categories, and the Indra Navia GBAS GS shall be able to handle all three categories.

Figure 2. CAT I: Landing systems classified for CAT I conditions may be used when the runway is visible at a height of 200 feet above the ground. For CAT II, the runway must be visible 100 feet above the ground, and CAT III is without visibility, so-called blind landing or zero visibility landing.

Description of work:

The GBAS GS under development at Indra Navia is currently a prototype. This prototype is installed at the airport in Frankfurt, and system tests and flight tests are being performed on the prototype, as part of the SESAR project. Other airport installations are planned in other projects. These projects will provide information on the conditions (the validity of the threat models), on the monitors' performance and permit tuning of thresholds and convergence windows, and also provide necessary inputs for installation, operation and maintenance procedures.

But, in order to be able to sell the GBAS GS as a product, it will be necessary to certify that the product meets the requirements set by ICAO. It will be necessary to show that monitors react to extremely rare events, with extremely low PMDs and PFAs. It will also be necessary to show that the entire system works as a whole, that the monitors are aligned in the "right order", and that the reaction of one monitor will not harm other monitors or parts of the system. It must be proved that the system meets the requirements, and the proofs must be proved valid. New software has been written, and the certification authorities do not dispose of any tool to verify the validity of new GBAS software, they have tools for ILS certification. So tools for software validation must be made, and it must be proved that the tools actually check what they are made for. The work proposed for the PhD student is to:

- Model the system end-to-end
- Simulate modules and the entire system
- Integrate monitors and modules in GBAS GS and prove that the entire system meets the requirements for availability, continuity and integrity
- Develop test methodology and test tools
- Test modules and the system on a pilot installation
- Documentation

The amount of work listed above is assumed to be more that what is possible to cover within one PhD, so restrictions may be necessary.

Required background:

Applicants for the PhD position must be in possession of a master's degree (or equivalent) in relevant field of science. Master students in their last year are also invited to apply: employment will then be postponed until the master degree is finished. The successful candidate must also satisfy the requirement for entering the PhD programme at NTNU. See http://www.ntnu.edu/ime/research/phd for more information about the PhD-programme at NTNU. PhD regulations require a master degree or equivalent with at least 5 years of studies and an average grade of A or B within a scale from A to E for passing grades. Candidates from universities outside Norway are kindly requested to send a Diploma Supplement or similar documentation, which describes in detail the study and grade system and the rights for further studies associated with the obtained degree.

Knowledge within the following areas will be preferable or required:

- Engineering
- System modelling and analysis
- Simulation
- Software development
- Test methodology and test tools
- Certification requirements/processes
- Fluent English oral and written

Great importance will be attached to personal suitability.

Salary and place of work:
The salary will be gross NOK. 450.000 per annum.

This PhD position is offered within the framework of the program "Industrial PhD" defined by the Norwegian Research Council, http://www.forskningsradet.no/prognett-naeringsphd/Home_page/1253952592752. As a temporary employee of Indra Navia, the main working place will be Indra Navia at Skullerud in Oslo. The PhD work will be full time for a period of three years. There is however a rule that the working time shall be divided between the company and NTNU with minimum one year at each location. The working periods are not necessarily continuous. The last year can be either place, or may include a stay abroad. Indra Navia has a good network within national and international universities, companies and research institutions, so the possibilities of finding interesting collaboration partners during the periods outside the company are good.

We are interested in candidates that can start working on the 01.01.2015, eventually 01.08.2015.

Formalities:

The application must contain:

1. cover letter summarizing applicant's motivation and accomplishments (1-2 pages)
2. CV with information about education, examinations and previous experiences
3. a list of publications
4. names of three references (name, address, email, and phone)
5. certified copies of testimonies and documents
6. certified copies of documentation on English language proficiency

Applicants who do not master a Scandinavian language must provide evidence of good English language skills, written and spoken. The following tests can be used as such documentation: TOEFL, IELTS or Cambridge Certificate in Advanced English (CAE) or Cambridge Certificate of Proficiency in English (CPE). Minimum scores are:
TOEFL: 600 (paper-based test), 92 (Internet-based test)
IELTS: 6.5, with no section lower than 5.5 (only Academic IELTS test accepted)
CAE/CPE: grade B or A.

Applications are to be sent through jobbnorge.no by link on this page, "apply for this job".
Closing date: 15th of August 2014.

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Tilleggsinformasjon

Arbeidssted: