CELESTIA | Antwerp

Direct Sequence Spread Spectrum (DSSS) Software Implementation for Satellite SDR Modem Application

About Celestia Antwerp

Celestia Antwerp is a leading company in Belgium, active in the field of satellite ground communication technology. It is part of the Celestia Technologies Group.

Celestia Antwerp's core business is in the delivery of satellite communication solutions for the ground segment extension with products and systems. Celestia Antwerp operates both on the commercial and institutional markets, supporting space agency programs, as well as industrial company projects worldwide. The company's activities have been in Antwerp since 1962, when it was founded as part of Bell Telephone.

Type and Description:

Type: Master Thesis

Description: Direct Sequence Spread Spectrum (DSSS) modulation techniques are widely used in digital communication systems to secure the space to ground communication link. Transmission gets protected against unintentional and intentional (aka jamming) interferences by increasing, i.e. spreading, the frequency of the transmitted signal over a much wider bandwidth. The space industry standardized spread spectrum for satellite operations in CCSDS 415.1-B-1 and ETSI EN 301 926 standards.

Typically, DSSS is implemented with Field Programmable Gates Array (FPGA) because it requires intensive computing operations when mixing the low-speed narrow-band initial signal with the high-speed wideband pseudorandom coding signal. However, tremendous improvements have been made to CPU architecture (e.g. SIMD = Single Instruction on Multiple Data) and Graphics Processing Units, offering excellent computing performance on vector operations and numeric manipulations through a high degree of parallel computations. Without reaching the performance level of FPGA, these improvements, however, make software implementation worthwhile considering as a low-cost but still performing solution for DSSS application. Hence, the scope of this project is to develop an accelerated software library for Direct Sequence Spread Spectrum following CCSDS recommendation.

Objective and Deliverables:

Objective: The objective of this thesis consists in the development of a novel and efficient software (eventually GPU aided) approach for a high-speed CCSDS Direct Sequence Spread Spectrum modulator and demodulator. The challenge resides in the ability to sustain, in software, the underlying computation complexity induced by the high sample rate and

the processing speed. The performance target is to get the maximum data rate (e.g. 100 kbps) and chip rate (at least 10 Mchips/s) possible while keeping the implementation loss as low as possible (e.g. below 0.5 dB). A fair comparison of hardware (GPU aided) and multi-core (multi-threaded and SIMD) software DSSS implementations will be driven. The thesis shall finish with a presentation to a mixed audience of academical & industrial experts.

Expected deliverables:

The following deliverables are expected:

- Documentation: Technical Specification, Detailed Design Architecture (Algorithms, Software), User Manual, Final Report, Final Presentation.
- DSSS modulator (executables and source code).
- DSSS demodulator (executables and source code).
- Testing tools (executables, source code and documentation).

Tasks:

The following tasks will be executed

- State of the art analysis
- Architecture Detailed Design
- Software implementation
- Testing, code optimizing, troubleshooting and bug-fixing
- Final report
- Final presentation.

Evaluation Criteria:

Evaluation Criteria

The following will be considered for the final evaluation.

- Demonstrated technical skills.
- Timeline of deliverables vs agreed plan.
- Quality of deliverable.
- Level of autonomy shown by the candidate.
- Motivation and initiatives taken.

Location

Celestia Antwerp
Roderveldlaan 1, 2600 Berchem, Belgium

More Information about Celestia and other potential internship or open vacancies:

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