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SPUTNIX CubeSat kit based on Raspberry-Pi

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CubeSat standard was created to democratize access to space for students. Nevertheless, development of CubeSat mission is still challenging today. Typical CubeSat components are quite expensive even for top-level universities. There are already some projects focused on reducing CubeSat missions cost but problem is still unresolved. Moreover, time by time students are faced same development problems instead of focusing on the subject of their CubeSat mission. Typical CubeSat OBC cost is more than 4000 euro, instead of it could be used COTS computer like Arduino or Raspberry-pi with cost is only around 40 euro. Raspberry-pi is a powerful computer with fully capable OS and plenty of already developed advanced software and libraries which are available for free. That's why SPUTNIX decided to use Raspberry-pi as a core of SPUTNIX CubeSat product line. Another feature is "SPUTNIX CubeSat API". It is a software library for Raspberry-pi. The library will dramatically save on board software development time, allowing users to focus on high level algorithms and mission goal rather than solving tasks on low level programming. SPUTNIX Raspberry CubeSat kit is designed for laboratory practice in school, university laboratories and for space mission as well. The CubeSat product line will be available in two options: 1U CubeSat with coarse magnetic stabilization system, and 3U CubeSat with 3-axis ADCS. Each of the options is suitable for a variety of educational and applied tasks, including: design of nanosatellite, systems engineering, structure design, space missions planning, satellite mission control and telemetry processing, on-board software development, nanosatellite assembling, engineering tests, payload integration and its maintenance in laboratory and on orbit.

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Development of relative navigation test-bed using GPS and femtosecond laser

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Formation flying using small satellites can be operated with lower budget. There is various formation flying missions. A precise relative navigation system is required to operate the formation flying with good performance. Sometimes a laser distance meter is utilized as distance measurement data for precise relative navigation. Many previous studies have used the laser distance data generated by software-based simulator which was formulated by femtosecond laser ranging theory. However, the previous studies did not include information from a real distance meter. The current study will present a real-time relative navigation test-bed based on GPS signal and miniaturized femtosecond laser distance meter. For this study, the laser simulator is developed to include actual hardware properties omitted in the former software-based simulator. An ultimate goal is to replace the laser data of software-based simulator with real measured data by the hardware of the laser distance meter. Short-distance simulations can be performed with a raw data measured by the distance meter. On the other hand, the measurement data should be generated by the simulator for long-distance simulations. To generate long distance information, the hardware properties should be improved to include the characteristics of design parameters and measurement errors. The design parameters in the simulator are modulated same as the manufactured instrument. The design parameters are associated with random noise of measured data. If a mathematical relation between them is deduced, the parameters can be estimated for a long-distance navigation in formation flying. The measurement errors of instrument contain not only errors of laser hardware parts but also errors of other device parts. The test-bed is developed by adding the errors of the device parts to the previous software-based data. With the integrated test-bed, the results can be used for a relative navigation utilizing femtosecond laser ranging data. The relative navigation algorithm developed in this study will be verified for spacecraft formation flying mission.

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