R005-P08
ポスター 3 ：11/25　PM1/PM2 （13:15-18:15）

#佐藤 洸太 1), 津田 卓雄 1), 雁金 沙弥香 1), 青木 猛 1), 斎藤 徳人 2), 野澤 悟徳 3), 川端 哲也 3), 川原 琢也 4), 高橋 透 5)
(1 電通大, (2 理化学研究所, (3 名大・宇地研, (4 信州大・工, (5 電子航法研

Development of a the time-delayed multi-beam observation method applied to the Tromsoe Na lidar

#Kota Sato1), Takuo Tsuda1), Sayaka Karigane1), Takeshi Aoki1), Norihito Saito2), Satonori Nozawa3), Tetsuya Kawabata3), Takuya Kawahara4), Toru Takahashi5)
(1The University of Electro-Communications, (2RIKEN, (3Institute for Space-Earth Environment Research, Nagoya University, (4Faculty of Engineering, Shinshu University, (5Electronic Navigation Research Institute

The sodium (Na) layers are normally distributed at 80-110 km altitudes in the merosphere and lower thermosphere (MLT) region. The Na resonance scattering lidar is a laser remote sensing system that can observe Na layers, which is one of the most powerful tools for measurements for the MLT region. In recent lidar observations, low-density Na layer events have been found at higher altitudes (up to 170 km), which are so-called thermospheric Na. These high-altitude Na evens have the potential to extend the lidar observation to higher altitudes.

The Tromsoe Na lidar was developed in 2009-2010 and is equipped with a laser diode (LD) pumped laser system, which has advantages in stability and lifetime. The Tromsoe Na lidar is capable of simultaneous multi-beam observation in 5 directions by splitting the 4-W power laser into 5 beams. The Inter-Pulse-Period (IPP) of the pulsed laser is 1 msec, and thus the corresponding observation range is 0-150 km. In other words, the Tromsoe Na lidar was originally designed for 80-110 km of Na layers, and it is not enough for observations for thermospheric Na events. To overcome this subject, we propose the time-delayed multi-beam observation method. In this method, we perform a pulse-to-pulse switching in the direction of the laser beam in the multi-beam lidar observations. If we apply this method to the two-direction observations of the Tromsoe Na lidar, the IPP in each direction becomes 2 msec, which corresponds to the range coverage of 0-300 km. To implement this method, we have been working on developments in a system for the pulse-to-pulse switching in the direction of the laser beam, and a data acquisition system, which fits the time-delayed multibeam laser sensing.

In this study, we focus on the feasibility of this pulse-to-pulse switching through fundamental experiments using a commercial galvanometer scanner. In the experiments, the galvanometer scanner was operated at every 1 msec, which is the same as the laser repetition period of the Tromsoe Na lidar system, and the laser beam line was switched in two directions. The two beam-lines were measured by photodetectors and beam profilers. Based on these experiments and the data analysis of experimental results, the switching time and beam pointing accuracy were evaluated. As a result, the switching time was 0.90 msec, which was found to be fast enough for the Tromsoe Na lidar system. The beam pointing accuracy was evaluated by simulations of transmitting beam size and receiving field-of-view (FOV) using geometric calculations. The simulation results indicate that the experimental results of the pointing accuracy are good enough for the Tromsoe Na lidar system. These results suggest that the time-delayed multi-beam method can be applied to the Tromsoe Na lidar using our experimental system equipped with the commercial galvanometer scanner.

In the presentation, we will show the details of the feasibility of the pulse-to-pulse switching, described above. The current status of development in the FPGA-based data acquisition system for the time-delayed multibeam laser sensing will be also reported.