Evaluation of Pad-Clearance at Lift-off based on Image Recognition Technology

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Abstract

It is important to acquire a behavior of a rocket after lift-off. This is because, this behavior is relevant to a clearance between the rocket and ground equipment, acoustic environment and acquisitions of positioning satellites. However, since avionics used in flight, for example pisitioning satellite tracking devices or on bord acceleration sensor, is indirect evaluation and include errors in measurement, their accuracies can be further improved. If the new system for measuring a rocket's position, velocity and attitude independently and accurately is developed, direct evaluation is realized, and it can contribute to the operation or designing of these avionics. Therefore, as the first step of this development, we aimed to measure the pad clearance, which is the distance between a rocket and a launcher, by analyzing image data taken from near the launch pad.

Reasons and benefits of using JAXA Supercomputer System

In order to calculate the pad clearance, calculations with two steps are required: 1) Detection of a rocket from image, 2) Acquisition of the three-dimensional position of the rocket. The deep learning model is applied to the former calculation and JAXA Supercomputer System is applied to the training of the model. As a result, large scale calculation of image processing can be conducted rapidly, and the whole processes of the measurement can work efficiently.

Achievements of the Year

By inputting image data, which is taken from near the launch pad, into the image recognition model trained by JAXA Supercomputer System, we successfully detect the serial three-dimensional positions of a rocket as shown in Fig,1. Moreover, by integrating two positional data at different position at the same time, we also success to measure height (for verification of this method, Fig.2) and pad clearance (the aim of this project, Fig. 3) quantitively and got reasonable values. On the other hand, we also recognized some problems, for example detection accuracy in very high or very low positions, vibration of cameras and lack of data, throughout this project, and we are going to improve this method based on these points in future.

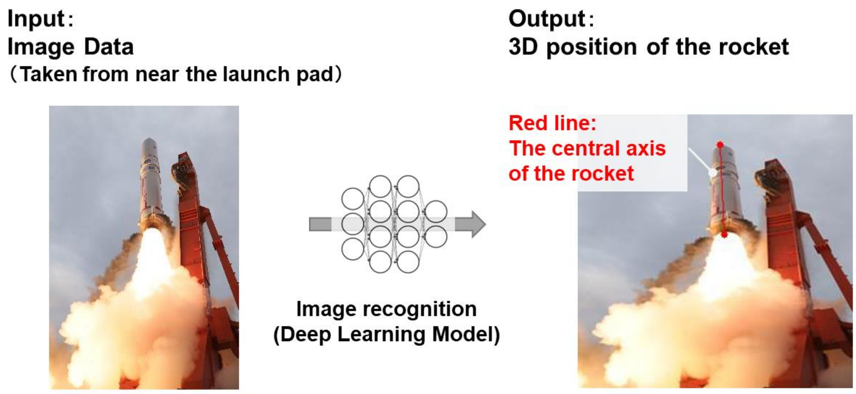

Fig. 1: The process of detecting a rocket position

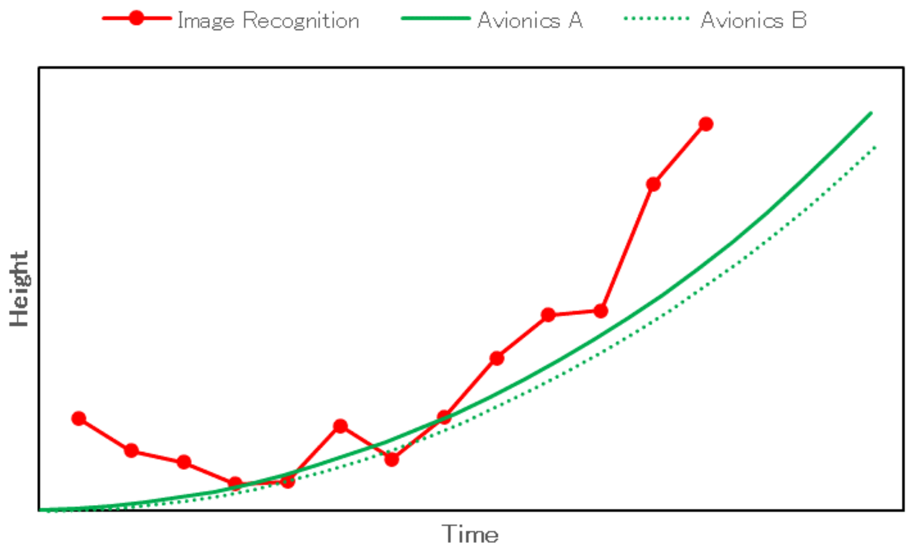

Fig. 2: The verification of the method using rocket's height (Comparison with existing avionics)

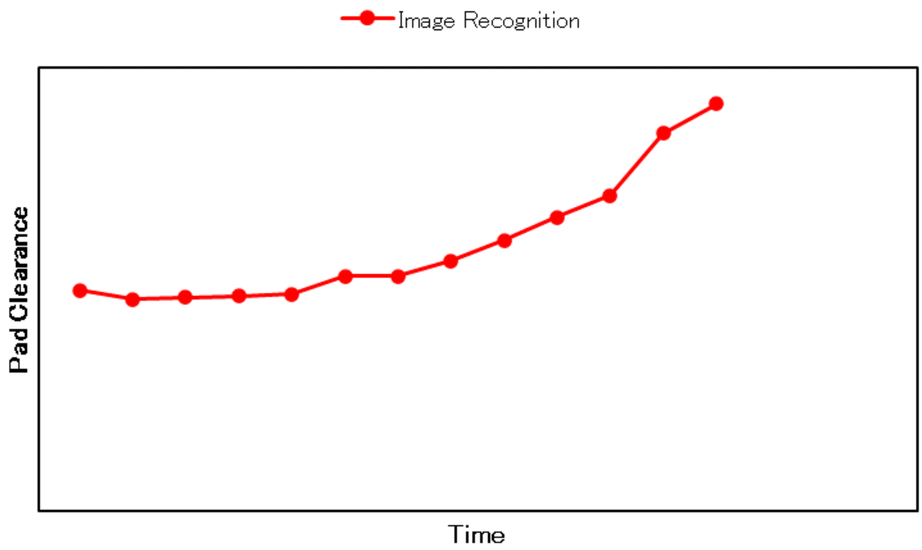

Fig. 3: Evaluated pad clearance values

- **Publications**

  N/A

- **Usage of JSS**

- **Computational Information**

Process Parallelization Methods	N/A
Thread Parallelization Methods	N/A
Number of Processes	1
Elapsed Time per Case	2 Hour(s)

- **JSS3 Resources Used**

Fraction of Usage in Total Resources*1(%): 0.00

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage*2(%)
TOKI-SORA	0.00	0.00
TOKI-ST	285.67	0.00
TOKI-GP	8.52	0.00
TOKI-XM	0.00	0.00
TOKI-LM	0.00	0.00
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage[*2] (%)
/home	2.50	0.00
/data and /data2	1,625.00	0.01
/ssd	25.00	0.00

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage[*2] (%)
J-SPACE	0.00	0.00

[*1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage[*2] (%)
ISV Software Licenses (Total)	0.00	0.00

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.