Astronomy and Astrophysics in the Gaia sky
Proceedings IAU Symposium No. 330, 2017
A. Recio-Blanco, P. de Laverny, A.G.A. Brown
& T. Prusti, eds.

doi:10.1017/S1743921317005269

Nano-JASMINE and small-JASMINE data analysis

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Abstract. Space astrometry missions Nano-JASMINE and small-JASMINE are planned in Japan. Data analysis tasks are performed under Gaia-JASMINE collaboration in long time. We expected to achieve 3 mas accuracy in Nano-JASMINE, and 20 micro arcsec in small-JASMINE of astrometric performance. Gaia DR1 publication and instruction is done from NAOJ and Niigata University.

Keywords. astrometry, infrared: galaxies

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1. Introduction

We are planning a series of space astrometry satellite mission(Gouda (2011)). Nano-JASMINE is a global astrometry mission with 5 cm aperture aiming to 3 mas. Small-JASMINE is a differential astrometry mission of very narrow region with near infrared band aiming to 20 micro arcseconds.

2. Overview

2.1. *Nano-JASMINE data analysis*

Nano-JASMINE data analysis will be done by the collaboration with Gaia DPAC AGIS team. Nano-JASMINE is a scanning astrometric satellite with two beam. Its observational strategy is the same as that of Gaia. By simply replacing IDT (Initial Data Treatment) and PDB (Parameter Database), we can apply Gaia AGIS for Nano-JASMINE data analysis. Checking applicability of AGIS to Nano-JASMINE parameters has been done by Dr. Daniel Michalik with Lund and ESAC members. We confirmed that 2.5 mas parallax accuracy will be expectable.

We are now implementing IDT for Nano-JASMINE. Calculating PSF fitted center is the most important parts of IDT. Principal component approach of template PSFs are already implemented and checked. The algorithm assums that we have knowledge of PSF shape. We are now replacing running solution for calculating PSF fitted center position of the each stellar images.

2.2. *small-JASMINE data analysis*

As small JASMINE is not a scanning satellite, but it observes by step stare observation, the strategy is different from that of Hipparcos and Gaia. So Gaia software cannot be used for its analysis. The essential parts are 1)calculate PSF fitted center of the each stellar image, and 2)plate adjustment / overlapping.

By using many stellar images, we calculate effective PSF(Anderson & King (2000)). Effective means that it is not purely optical PSF, but convoluted with detector response. It is observable. For checking the accuracy of PSF fitted center, we show pixel phase error (Anderson & King (2000)) i.e. the difference between true center and estimated center in sub pixel level in Fig. 1. We can achieve 1/300 pixel (Peak) accuracy for constructing ePSF from simulated PSFs. We also check real observed data provided by HST group. By comparing positions of PSF fitted center by using ePSF provided by HST group and ePSF which we construct, the difference is less than 1/100 pixels.

For adjusting plates, we use bi-polynomial. The order is flexible. We check 4th or 5th order.

$$x(t) = \xi_0(t) + a_{10}(t)\xi + a_{01}(t)\eta + a_{20}(t)\xi^2 + a_{11}(t)\xi\eta + a_{02}(t)\eta^2 + \cdots \tag{2.1}$$

$$y(t) = \eta_0(t) + b_{10}(t)\xi + b_{01}(t)\eta + b_{20}(t)\xi^2 + b_{11}(t)\xi\eta + b_{02}(t)\eta^2 + \cdots \tag{2.2}$$

Accuracy of plate adjustment is evaluated by simulation and by using HST plates.

There may also be expected to exist pixel wise size in uniformity. For correcting this, we also consider the calibration operation. We observe globular cluster or some other dense region, and take picture by dithering telescope. In 50 min, assumption that all stars on the picture has the same position. By using this constraint, we can solve the geometry of the detector. It was done by Heidelberg group.

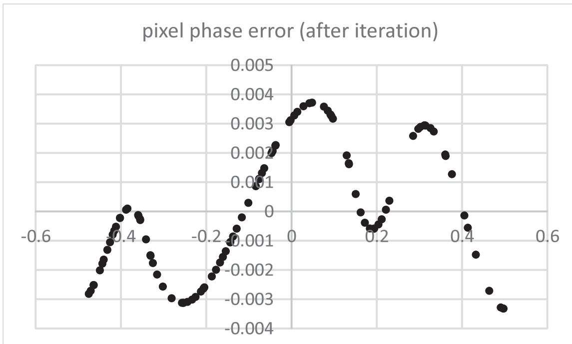

Figure 1. Pixel phase error of generated ePSF. The abscissa is the pixel phase of true center, and the ordinate is the difference between true and estimated center in the unit of pixel.

3. Gaia Data release from Japan

Within the collaboration of Gaia-JASMINE in GENIUS, NAOJ becomes one of the partner data center of Gaia data release. Characteristics of the database is very high performance system. `http://jvo.nao.ac.jp/portal/gaia.do`.

Also within the collaboration, Japanese explanation of Gaia data characteristics and instruction of the usage of DR1 data (`http://astro1.sc.niigata-u.ac.jp/~nishi/Gaia/GaiaDR1top.html`) which helps many Japanese professional and amateur astronomers.

This work has made use of data from the European Space Agency (ESA) mission *Gaia* (`https://www.cosmos.esa.int/gaia`), processed by the *Gaia* Data Processing and Analysis Consortium (DPAC, `https://www.cosmos.esa.int/web/gaia/dpac/consortium`). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the *Gaia* Multilateral Agreement.

References

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