USE OF THE COMBINED CCD OBSERVATION METHOD FOR FAST NEAR EARTH OBJECT OBSERVATIONS IN RI NAO. O. Shulga, Y. Kozyryev, Y. Sibiryakova, Research Institute "Nikolaev Astronomical observatory" (RI NAO), Ukraine. Email: tttt_nao@mail.ru.

There is a difficulty of observation of the fast NEO objects with speed V > 10"/sec. That type of objects can't be observed in prolonged exposure with classical way which is used for observing stars. So limiting magnitude of telescope can not be reached. In order to increase magnitude of observing objects the selection of tracking mode is necessary. It is possible to have the following tracking modes:

- Digital - stacking of shifted images obtained in short exposure time;
- Mechanical - moving telescope around its two axes precisely;
- Electronic - tracing of electronic charge through the CCD matrix.

The electronic tracking technique was designed in RI NAO. Observation is carrying out while object is passing through the field of view of unmovable telescope. So limited exposure time is depends from object speed and field of view size. This method can be used for observation of objects with any visible speed: from stars to low Earth orbit satellites.

The electronic tracing technique, designed in RI NAO, is based on Drift-Scan Imaging or Time Delayed Integration (TDI). The Drift-Scan Imaging technique is usually used to image long continuous strips of the sky. To make a scan it is necessary to read the lines of the CCD in perfect synchronization with the movement of the stars at the focal plane. It is also important to perfectly align the lines with east-west direction. In RI NAO this technique has been used on Meridian Circle telescope since 1995. The field of application of the Drift-Scan Imaging technique can be extended considerably with possibility of rotation of the CCD camera to the certain angel. In that case it can be used for observation of any object which is uniformly moving through the field of view. For that purpose special rotation system (image 1) was designed in RI NAO. The rotation system is a device in which a stepping motor and an angle encoder were equipped and which makes the rotation of CCD camera around telescope optical axis.

The electronic tracing technique was tested on very small telescope so only relative advantage can be showed. The test observation of asteroid 2007 TU24 was realized with use this method. On 2008-01-30 the asteroid speed was -9.3"/min on right accession, -28.9"/min on declination, magnitude 12.1. The asteroid was observed on an unmovable telescope with the classical drift-scan imaging technique and with the rotation system (image 2). Exposure time - 240 sec, so while the exposure time the asteroid have passed 120" or 55 pixels.

Images obtained with object tracking mode (mechanical or electronic) contains round image of object but stretched images of stars which are difficult for data reduction. To avoid this problem the special additional frames with different mode are made before and after object frame.

Image 1. Rotation system with CCD camera

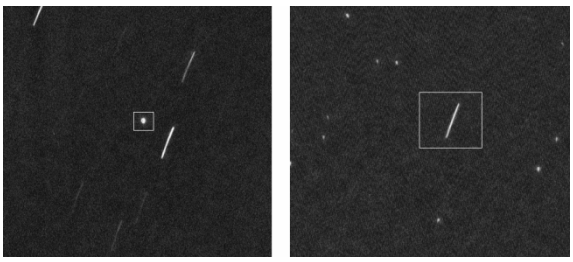

Image 2. Images from different drift-scan observations. Left: Classical drift-scan imaging, right: Drift-scan imaging with rotation system

Telescope is unmovable so it not a problem to connect the object coordinates and the reference stars coordinates obtained on different frames in different time. The easiest way to obtain reference stars frame on stare telescope is to use very short exposure time. While observation of the fast NEO objects on an unmovable telescope it is possible to use driftscan imaging with variable small exposure time to obtain reference stars frame.

The electronic tracking technique can provide results which are comparable to observations on precise tracking telescope for wide object types from fast NEO objects to fast low Earth orbit satellites. The most telescopes in Ukraine and Russia which are used for asteroids observations are old and can't track any objects except stars. The most easier and inexpensive way of modernization for tracking capability is to install the rotating system and CCD camera which support driftscan mode. RI NAO collaborating with Shanghai Astronomical Observatory carries out the common project in use of the electronic tracking technique.