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Space sUrveillance and Near-Earth asteroids Detection Using Synthetic Tracking. Sun-dust

The objective of the Sun-dust project is to carry out sky survey in order to search for new near-Earth asteroids. To this end the observational campaigns with telescopes Panoptes-1A (Gdynia, Poland), Solaris-3B (Siding Spring Observatory, Australia) and Solaris-2 (South African Astronomical Observatory, South Africa) will be held. The synthetic tracking technique will be applied in the survey.

Near-Earth asteroids are the objects located into orbits that allow them to enter the Earth's neighbourhood. They are moving with high angular velocity, so they can move a distance equal to a few diameters of the Moon during one night. What is more, the vast majority of unknown NEAs are smaller than 50 m. Due to that, asteroids reflect only small amount of the solar light and are dim. Detection of near-Earth asteroids requires complex treatment and is challenging.

The synthetic tracking technique allows detecting faint and fast-moving objects like near-Earth asteroids. A solution is to acquire many images using shorter exposure times, then shift and add frames. If asteroid is located in the pictures and its angular motion is corresponding to the shift vector, after processing the asteroid appears to be a clear blip. This approach avoids signal loss due to smearing asteroid's image in a larger area of the detector. The synthetic tracking makes it possible to detect fainter and faster objects than traditional techniques. This technique takes advantage of recently appearing on the market technologies: new generation of high-speed, low read-noise sCMOS cameras and computing power of modern computers.

In general, detection and characterization of near-Earth asteroids is desired because of a few reasons. Firstly, we are curious as scientists and also inhabitants of the Earth of our cosmic neighbourhood and want to know origins of our planet. Asteroids are lumps of the interplanetary matter orbiting the Sun. It is believed that they are relatively unchanged leftovers from a planetary system forming process. It means that building blocks of the Solar System are located somewhere in space. Finding and studying asteroids could provide important information about processes occurring during the evolution of the planetary system. Secondly, detection of asteroids is not only important from scientific point of view. It is also valuable from planetary defense point of view. Even small asteroid could cause a lot of harm entering into the Earth's atmosphere. The most recent well reported incident caused by NEA took place over the city of Chelyabinsk in Russia on February 15th, 2013. The asteroid exploded over the city destroying fifteen hundred of buildings and hurting hundreds of people. Early detection of the hazardous object allows avoiding collision or mitigating its impact. Another reasons for looking for near-Earth asteroids is the space exploration. This is a vision of the dreamers and the enthusiasts of an unconventional action on the edge of the science and fiction. Asteroids could be used as a source of raw materials to build an extraterrestrial colony or to supply spacecrafts.