Technical Overview of the ASTRA Project

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Abstract. We report on relevant technical advances for system and data-flow control for the forthcoming ASTRA (All-Sky TRacking Array) network of wide-field cameras for LEO traffic survey and tracking. The ASTRA network will consist of five twin stations, suitably located across the Italian territory. Each station will be steerable and equipped with an ultra wide-angle (80°x60° FOV) f/1.4 Voigtlander NOKTON optic mounted on a Sony mirrorless camera, eventually accompanied by several ancillary devices for focusing, weather control, azimuth steering, temperature control etc.. All these devices are controlled by Raspberry Pi that is remotely linked with the INAF SSA Control Center in Loiano (Bologna). The ASTRA sensors aim of surveying the entire orbital traffic of metric-size objects (including satellite mega-constellations and potentially dangerous massive debris in pre-reentry trajectories) flying over the Italian sky within an altitude of ∼1000 km. In order to achieve the required astrometric precision of 5-7 arcsec (namely some 8-10 meters at LEO altitudes), each ASTRA station will be clocked by a GPS module with a PPS (Pulse per Second) signal, used to synchronize the internal Raspberry unit control clock. With this method, in addition to a precise modelling and electronic characterization of the shot delay, we are able to achieve a millisecond accuracy in the true start exposure time and image lapse. We also plan to implement a pipeline to raw-image handling and compression, and plate solving algorithm to recognize and extract any trailing object, in order to consistently derive its actual TLE solution just on the basis of one passage across the sky.

Keywords: Wide-field optical network · LEO tracking · PPS handling.