# CoLiTec-multifunction software for the CCD image processing

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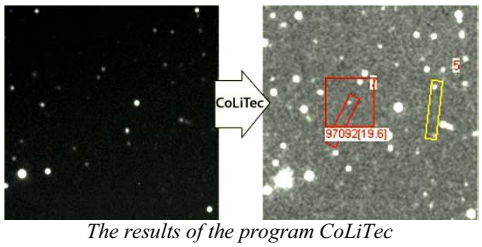
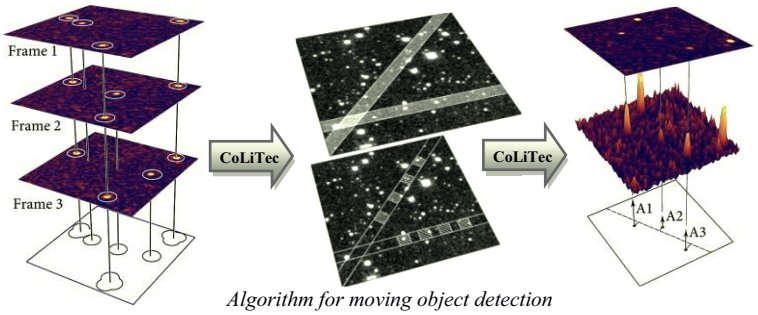
## Advantages of software for CCD-image processing and detection of small solar system bodies CoLiTec:

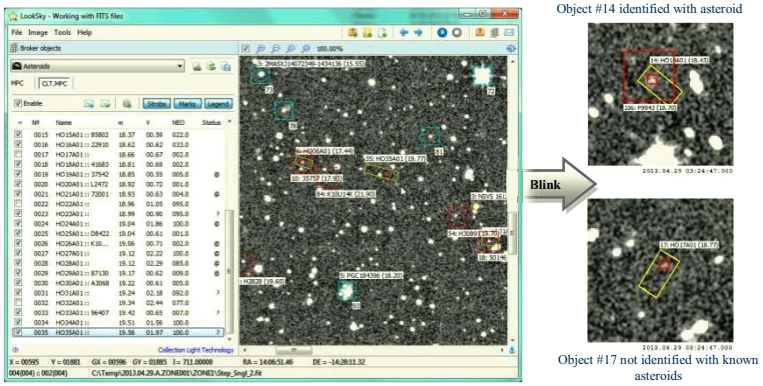
- Automatic detection of faint moving objects (SNR>2.5);
- Working with very wide field of view (up to 10 degrees²);
- Auto calibration and cosmetic correction;
- Fully automatic robust algorithm of astrometric reduction;
- Automatic rejection of objects with worst observations;
- Results viewer (LookSky) with graphical user interface ;
- Multi-threaded support for multi-cores systems and local network ;
- Processing pipeline managed by OLDAS (OnLine Data Analysis System).




*The results of the program CoLiTec*




*Algorithm for moving object detection*




Object #14 identified with asteroid

Object #17 not identified with known asteroids

*LookSky - Visual inspection of the processed results*

## RESULTS (MAY, 2010 – MARCH, 2015):

- The CoLiTec led to the first automated asteroid and comet discoveries in the countries of the former USSR.
- **Observatories-CoLiTec users**: 5 (AAO [A50], ISON-NM [H15], ISON-Ussuriysk [C15], ISON-Kislovodsk [D00], Odessa-Majaki [583]).
- **Observations**: about 600 000. Objects discovered: 1558 asteroids and 4 comets.
- **Comets**:

C/2011 X1 (Elenin) (MPEC 2010-X101) – December 10, 2010 (ISON-NM),
P/2011 NO1 (Elenin) (MPEC 2011-O10) – June 7, 2011 (ISON-NM),
C/2012 S1 (ISON) (MPEC 2012-S63) – September 21, 2012 (ISON),
P/2013 V3 (Nevski) (MPEC 2013-V45) – October 8, 2013 (ISON-Kislovodsk).

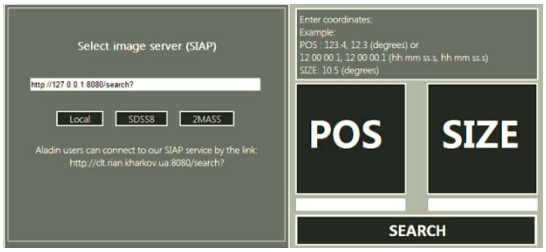
- **Jupiter Trojans**: 2010 XR32, 2010 XG21, 2010 VO138, 2010 VT36, 2011 QJ9, 2011 QQ47, 2011 QZ75, 2011 YD47, 2011 YA3, 2011 QB76, 2012 SC50, 2012 AF1, 2012 CF52, 2012 BB27, 2012 RZ4, 2012 RM6, 2012 SD3, 2012 SN9, 2013 BP2, 2013 UF9, 2013 VD
- **Near-Earth Asteroid**:

2011 QY37 (MPEC 2011-Q51) - August 27, 2011 (ISON-NM),
2012 RQ16 (MPEC 2012-S16) – September 17, 2012 (D00),
2013 TB80 (MPEC 2013-T86: 2013 TB80) – October 10, 2013 (ISON-NM),
2014 KH2 (MPEC 2014-K23: 2014 KH2) – May 21, 2014 (ISON-NM).

- **Other Unusual Objects**: 2011 HY52 – April 24, 2011 (AAO), 2011 QD23 – August 25, 2011 (ISON-NM), 2011 RC17 – September 2, 2011 (ISON-NM).
- **Centaurs**: 2013 UL10

## Frame storage and publication software:

- Management of archive, including searching for data by parameters (coordinates);
- External access via our web-interface and Aladin software (Generic SIA query);
- Retrieve additional data via VizieR (SDSS v8 and 2MASS);
- Software used SIA protocol and VOTable format.




*Access to web-interface – [http://91.212.253.48:8080/siap](http://91.212.253.48:8080/siap)*

## Top-10 most prolific observatories in 2011-2012 (MPC)

**Top-10 observatories from measurements**

| № | Observatory (MPC-code) | Measurements | Discoveries |
|---|---|---|---|
| 1 | Mt. Lemmon Survey | 4186400 | 39446 |
| 2 | Lincoln Laboratory ETS, New Mexico | 3637872 | 719 |
| 3 | Pan-STARRS 1, Haleakala | 3506255 | 27413 |
| 4 | Catalina Sky Survey | 3235680 | 5273 |
| 5 | Steward Observatory, Kitt Peak-Spacewatch | 1708543 | 15956 |
| 6 | Siding Spring Survey | 479198 | 757 |
| **7** | **ISON-NM Observatory, Mayhill** | **252848** | **1106** |
| 8 | Apache Point-Sloan Digital Sky Survey | 227025 | 7 |
| 9 | Purple Mountain Observatory, XuYi Station | 195221 | 356 |
| 10 | WISE | 163006 | 23 |

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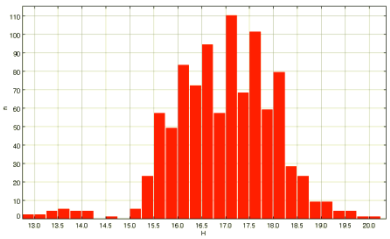
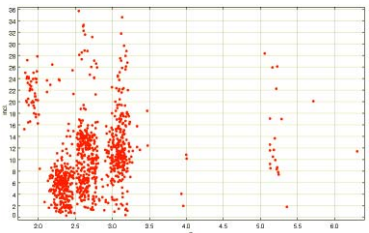
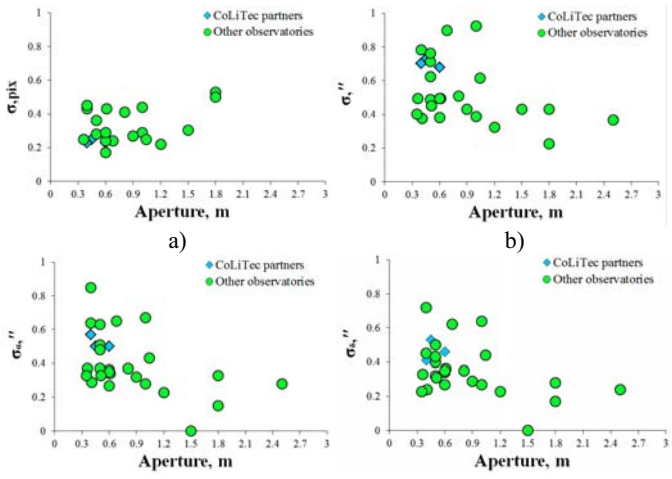
| 4 | Catalina Sky Survey | 3235680 | 5273 |
| 5 | Palomar Mountain--PTF | 28638 | 1827 |
| 6 | Palomar Mountain/NEAT | 56878 | 1286 |
| **7** | **ISON-NM Observatory, Mayhill** | **252848** | **1106** |
| 8 | University of Szeged, Piszkesteto Stn. (Konkoly) | 51885 | 952 |
| 9 | OAM Observatory, La Sagra | 51927 | 802 |
| 10 | Siding Spring Survey | 479198 | 757 |



*Absolute magnitudes of discovered objects (H15)*



*Designations (H15) Semi-major axis vs inclination*




*Most prolific world asteroid surveys in 2012*

*a) standard deviation estimations of object position, in pixels; b) standard deviation estimations of object position, in arc seconds; c) standard deviation estimations of object position in the right ascension, in arc seconds; d) standard deviation estimations of object position in the declination, in arc seconds.*

**You can download free version of CoLiTec software:**

**[http://www.neoastrosoft.com](http://www.neoastrosoft.com)**

**Collection Light Technology**

*Software for automated asteroids and comets discoveries*