3 000 000 LCs in EDMOND database

Roman Piffl / CEMeNt / EDMOND

3 000 000 LCs in EDMOND database

- EDMOND contents data about **3 060 250** meteors (31. 12. 2014)
- Combination of that data produce **210 887** orbits of meteors (after reduction by means of qualitative criteria)
- Source data from MetRec and UFO Tools contain not only astrometric information
- In that data we can find also informations about meteor brightness
- But...
- **Data on brightness are not used** (except in the case of absolute magnitude)
- So...
- There are 3 million meteor lightcurves hidden in our database!

3 000 000 LCs in EDMOND database

- How to unhide that LCs?

1. Because MetRec and UFO Tools have a different format of data storage, we need two conversion utilities to obtain data on brightness.
2. We need to choose optimal format of data storage for further processing.
3. We need to create some utilities for combination of multistation meteor lightcurves.
4. We need to create tools for combination LCs with data about atmospheric trajectory.
5. We need to create a graphical interface for new database to be welcoming to the user.

3 000 000 LCs in EDMOND database

Format of MetRec data

- MetRec data are in two files
  1. *.ref file
     a) it contains data about site of observation
     b) data about refences stars
  2. *.inf file
     a) It contains data about *.ref file
     b) data about captured object
        i. Time
        ii. Magnitude
        iii. RA and DEC

Format of UFO data

- UFO data are in one XML file
  1. It contains detailed information about station, camera and captured object
  2. Captured object is determined frame by frame with information about
     a) Frame number
     b) Sum of luminosity
     c) Magnitude
     d) Azimuth and elevation
     e) RA and DEC

```
SiteCode 14270
Longitude 11.191670
Latitude 46.144199
Altitude 680
OperationMode unguided
ReferenceDate 2012 4 8
ReferenceTime 19 30 0
NoiseLevel 6
MaxStarDiameter 5.9
MinStarDiameter 1.0
VideoBrightness 240
VideoContrast 255
CenterOfPlate  192  144
OrderOfPlateConstants 3
NumOfRefStars 134
RefStar1  1.8  1.1   363  11.0620  61.7510 128.75  24.50
RefStar2  1.8  0.0   259  12.9000  55.9600  46.50  72.00
RefStar3  3.0  1.6   149  10.3720  41.4990 212.00 123.75
RefStar4  2.3  0.0   215  11.0310  56.3820 140.25  54.50
```

MetRec

*.ref file

```
AppearanceDate 01.01.2013
AppearanceTime 17:13:53
ReferenceStars 20120408.ref
FrameCount 20
#   time  bright   x      y      alpha     delta    c_x    c_y    c_alpha  c_delta  use
01  53.447 ----  0.246  0.735    3.3154   54.752  -----  -----  --------  -------  no
02  53.487 ----  0.247  0.717    3.3228   53.935  -----  -----  --------  -------  no
03  53.527 ----  0.247  0.700    3.3306   53.119  -----  -----  --------  -------  no
04  53.567  2.6  0.248  0.682    3.3384   52.304  -----  -----    3.3364   52.328  yes
05  53.607  1.8  0.249  0.665    3.3462   51.490  -----  -----    3.3455   51.453  yes
06  53.647  2.2  0.249  0.645    3.3535   50.567  -----  -----    3.3544   50.576  yes
07  53.687  2.0  0.250  0.627    3.3599   49.729  -----  -----    3.3629   49.699  yes
08  53.727  1.9  0.250  0.607    3.3726   48.813  -----  -----    3.3711   48.820  yes
09  53.767  2.0  0.251  0.588    3.3774   47.909  -----  -----    3.3791   47.940  yes
10  53.807  2.1  0.252  0.569    3.3872   47.042  -----  -----    3.3868   47.059  yes
11  53.847  1.8  0.252  0.550    3.3970   46.159  -----  -----    3.3943   46.176  yes
12  53.887  2.0  0.253  0.532    3.4019   45.321  -----  -----    3.4015   45.292  yes
13  53.927  2.1  0.254  0.513    3.4082   44.434  -----  -----    3.4085   44.407  yes
14  53.967  2.2  0.256  0.493    3.4126   43.493  -----  -----    3.4153   43.531  yes
```

MetRec

*.inf file

```
<ua2_object
   fs="48" fe="88" fN="41" sN="15"
   sec="0.800000" av="4.877322" pix="31" bmax="75"
   bN="0" Lmax="221.739136" mag="1.638045" cdeg="0.015166"
   cdegmax="0.033879" io="3" raP="352.863861" dcP="-9.014144"
   av1="4.958315" x1="317.848053" y1="117.213600" x2="339.450806"
   y2="84.878815" az1="6.649399" ev1="26.623760" az2="9.405540"
   ev2="23.147804" azm="8.190636" evm="24.710350" ra1="285.862976"
   dc1="67.902039" ra2="281.802765" dc2="63.951656" ram="283.466858"
   dcm="65.733444" class="Iw_JNO" m="0" dr="1.019535"
   dv="6.269828" Vo="17.428900" lng1="17.544207" lat1="49.604111"
   h1="88.947037" dist1="193.056763" gd1="170.232208" azL1="48.778595"
   evL1="33.974815" lng2="17.679779" lat2="49.680882" h2="80.654999"
   dist2="197.310410" gd2="180.078674" len="15.383389" GV="19.229235"
   rao="83.860466" dco="-6.256966" Voo="19.900000" rat="80.024834"
   dct="-12.037234" memo="">
  <ua2_objpath>
<ua2_fdata2 fno=" 48" b=" 57" bm="000" Lsum="   134.3" mag="+2.18" az="   6.6660063" ev="  26.6565424" ra=" 285.8065933" dec=" +67.9311187"></ua2_fdata2>
<ua2_fdata2 fno=" 50" b=" 50" bm="000" Lsum="   125.5" mag="+2.26" az="   6.7857677" ev="  26.4491647" ra=" 285.6411454" dec=" +67.7062173"></ua2_fdata2>
<ua2_fdata2 fno=" 55" b=" 61" bm="000" Lsum="   174.5" mag="+1.90" az="   7.0848572" ev="  26.0707392" ra=" 285.1613713" dec=" +67.2802796"></ua2_fdata2>
<ua2_fdata2 fno=" 62" b=" 62" bm="000" Lsum="   150.9" mag="+2.06" az="   7.5757514" ev="  25.5047346" ra=" 284.3694922" dec=" +66.6324615"></ua2_fdata2>
<ua2_fdata2 fno=" 63" b=" 51" bm="000" Lsum="   111.7" mag="+2.38" az="   7.6538340" ev="  25.4433848" ra=" 284.2304020" dec=" +66.5570946"></ua2_fdata2>
<ua2_fdata2 fno=" 66" b=" 71" bm="000" Lsum="   177.8" mag="+1.88" az="   7.8280007" ev="  25.1514348" ra=" 284.0089007" dec=" +66.2374626"></ua2_fdata2>
<ua2_fdata2 fno=" 68" b=" 60" bm="000" Lsum="   180.5" mag="+1.86" az="   7.9660560" ev="  24.9883563" ra=" 283.7980499" dec=" +66.0504868"></ua2_fdata2>
<ua2_fdata2 fno=" 72" b=" 75" bm="000" Lsum="   199.7" mag="+1.75" az="   8.2160931" ev="  24.6903968" ra=" 283.4232339" dec=" +65.7087180"></ua2_fdata2>
<ua2_fdata2 fno=" 73" b=" 64" bm="000" Lsum="   195.3" mag="+1.78" az="   8.2302146" ev="  24.6111327" ra=" 283.4370376" dec=" +65.6286232"></ua2_fdata2>
<ua2_fdata2 fno=" 74" b=" 62" bm="000" Lsum="   168.2" mag="+1.94" az="   8.3310792" ev="  24.5072841" ra=" 283.2789541" dec=" +65.5064541"></ua2_fdata2>
<ua2_fdata2 fno=" 79" b=" 67" bm="000" Lsum="   221.7" mag="+1.64" az="   8.6542723" ev="  24.1528122" ra=" 282.7918299" dec=" +65.0930027"></ua2_fdata2>
<ua2_fdata2 fno=" 80" b=" 71" bm="000" Lsum="   185.9" mag="+1.83" az="   8.7556653" ev="  24.0191475" ra=" 282.6538721" dec=" +64.9412145"></ua2_fdata2>
```

UFO Analyser

*.XML file

3 000 000 LCs in EDMOND database

MetRec brightness determination

- In the first detection step, a mean background image is subtracted from the digitized frame. The mean image is derived from the previous frames. Negative pixel values in the difference image are set to zero, so that only pixels with increased brightness are further examined.

UFO brightness determination

- The magnitude of one field is computed from light sum of the pixels of the object in one field. Light sum is the sum of the increased light of pixels of the object.

  Increased light = brightness of the pixel at the instance – brightness of the pixel before the appearance of the object.

- Background is mean of 10 frames before.

3 000 000 LCs in EDMOND database

- After conversion, we can create database with following format:
  1. Station (latitude, longitude, altitude)
  2. Camera (FOV, sensor, resolution etc.)
  3. Informations about each frame
     a) Date and time
     b) Lsum (only from UFO data)
     c) Magnitude
     d) Azimuth and elevation
     e) RA and DEC
  4. Image of meteor (only from UFO data?)

3 000 000 LCs in EDMOND database

- Problems with obtained data
  1. No informations about reduction – we need to use that data „as it is“
  2. No reduction for following effects:
     a) distance
     b) speed
     c) vignetting and field distortion
     d) meteor parts (shock waves, body, foot)
     e) in frames of video data are often lacking owing to the impossibility of detecting peak
     f) background noise
     g) saturation (above 255 level)
     h) spectral sensitivity
     i) extinction, refraction, the effect of height above the horizon at the signal level (increased background etc.)
     j) light pollution

3 000 000 LCs in EDMOND database

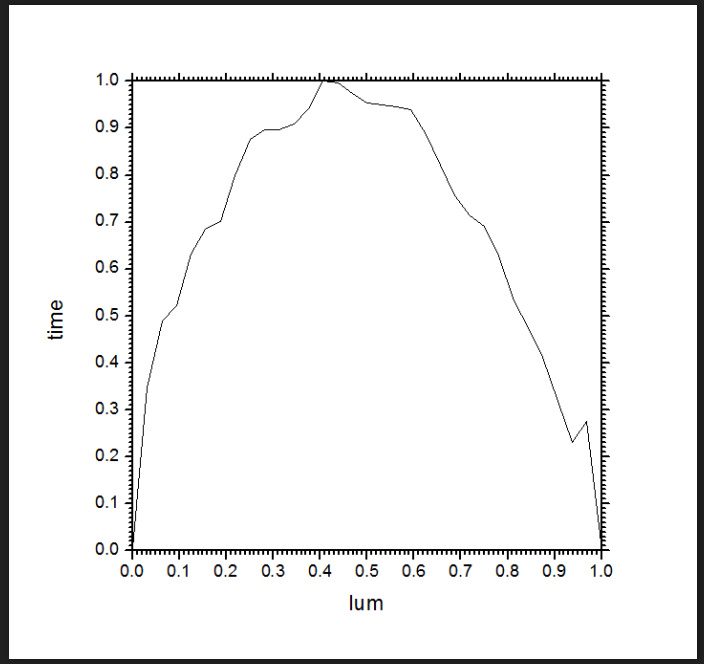
- Benefits of that database
  1. Big data for statistics analyses
  2. In combination with EDMOND database:
     a) Determination of typical LCs for more than 300 regular showers
     b) Determination of typical LCs for outbursts
     c) Comparison of LCs year by year and filament by filament for big showers
     d) Investigation of preheating phase for high altitude meteors
     e) Investigation of fragmentation and physical parameters for different types of meteoroid bodies
     f) Etc.

3 000 000 LCs in EDMOND database

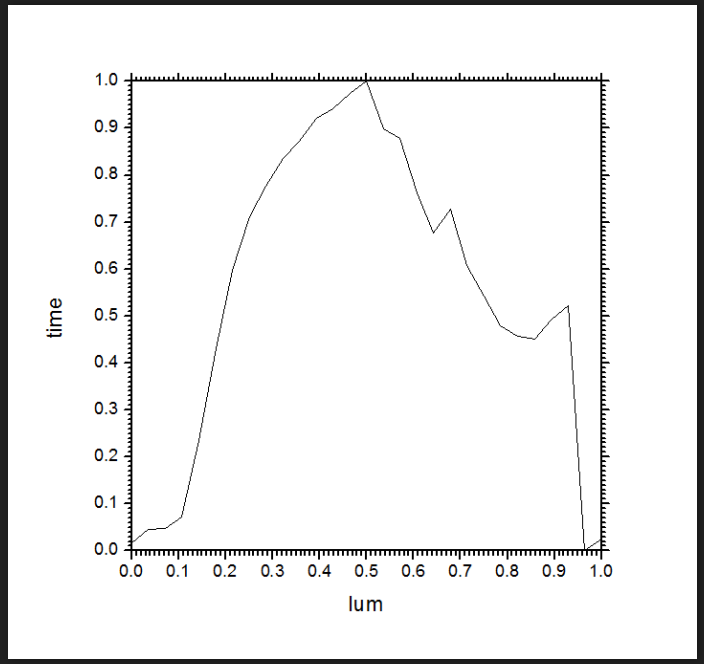
- Current status
  1. Data collection for additional data mining
  2. Creating procedures for populating the database (for UFO it is done)
  3. Creating GUI for database usability
  4. Testing of charting normalized curves (with data of outburst of DRA and SPE)
  5. Searching for a suitable name of LCs database
     (working name is **METaLICA** – METeor LIght Curve dAtabase)
- Timetable
  1. End of 2015 – conversion procedures will be done
  2. Spring 2016 – database in testing mode
  3. IMC 2016 – presentation of database

3 000 000 LCs in EDMOND database

Normalized LC of Draconid



Normalized LC of Draconid with flash



3 000 000 LCs in EDMOND database

- Any questions?

Thank you for your attention!

Roman Piffl / CEMeNt / EDMOND / METaLICA