Fireballs, meteors and shooting stars in science education

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Topics in this talk

- Solobservatoriet (Harestua Solar Observatory, Norway)
- Dust in space
- Geometry and mathematics in observations
- All-sky cameras and projections
- Meteor observations
- Calculating their origin and target
- Examples using Geogebra
Solobservatoriet
Dust in the solar system
Celestial coordinate systems

Elevation = height above the horizon (angle, degrees)
Azimuth = north/south/east/west (angle, degrees)
All-sky cameras

Pros and cons with views (here Fish-eye):
• Zenith «makes sense»
• Less distortion of tracks

This rig of four cameras at Solobservatoriet acts as one all-sky camera.
All-sky cameras

Pros and cons with views (here Panorama):
• Horizon «makes sense»
• Upright image
• Most meteors are visible low in the sky
A growing network of cameras

Norway: 4 (6) cameras
http://ildkule.no
v/Norsk Meteornettverk, Steinar Midtskogen

Sweden: 16 cameras
http://www.astro uu.se/~meteor/
v/Uppsala Universitet, Eric Stemples

Denmark: 8 cameras
http://www.stjerneskud.info
http://www.ildkugle.dk/
(v/Nordjysk Astronomisk Forening og Anton Norup Sørensen)
Detecting meteors with multiple cameras

- Verification by simultaneous events
- Triangulation of meteors
  - precise positioning
- Gives great material for discussing
- precision of measurements!
Precise maps of the Swedish and Danish networks
Understanding the images

Identifying a meteor – A suitable task for younger kids?

...and how to make sense out of this?

```c
// Is movement speed in allowed range?
if ((dist < diffpos_threshold*n) || (dist > diffpos_hilim*n)) {
    if (verbose) fprintf(stderr," Cancelled by diffpos_threshold\n");
    n_diff_triggered = 0;
    n_diff_triggered_conseq = 0;
}

// Is movement in a straight line?
if (n < n_diff_triggered_conseq-1) {
    if (verbose) fprintf(stderr,"Angle %5.2f PrevAngle %5.2f AngleLimit %5.2f\n";
    if (abs(prev_angle - angle) > angle_hilim/2/n) {
        if (verbose) fprintf(stderr, "Cancelled by angle limit\n");
        n_diff_triggered = 0;
        n_diff_triggered_conseq = 0;
    }
}

prev_angle = angle;
```

if (n_diff_triggered_conseq >= diff_consec_limit && !trig_delay_running) {
    fprintf(stderr,"Delayed saving timer started!\n");
    trig_delay_running = TRUE;
}
http://ildkule.no/ 

- Large event archive 
- Images, data, raw-files
Fireball event
22.nov 2015 kl.17:34:44 UTC
http://ildkule.no/meteor/20151122/173455/
22. nov 2015 kl. 17:34:44 UTC

http://ildkule.no/meteor/20151122/173455/
Fireball event
http://ildkule.no/meteor/20150812/235039/

https://www.youtube.com/watch?v=yPom1N7F-qE
http://ildkule.no/meteor/20150812/235039/

http://ildkule.no/meteor/20150812/235039/
Using geogebra
Future work

- We have enough cameras to do a lot of interesting observations, but...
- We want more collaborating schools and cameras
- Develop «Tinder for meteors» (swipe left for meteor, right for planes, UFOs, bugs and lens flares.
- ... (place your vote here)

We want feedback on:
- How should «Tinder for meteors» work?
- Existing cameras we can include in our data-exchange network (in UK, Latvia, Finland, Iceland)?