Geosci. Instrum. Method. Data Syst. Discuss.,
doi:10.5194/gi-2016-30-AC1, 2017
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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Analysis of the technical biases of meteor video cameras used in the CILBO system" *by* Thomas Albin et al.

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Received and published: 30 January 2017

Dear Mr. Gural, the anonymous reviewer and the GI editor board as well as Mr Vazquez,

please find attached the edited version of the paper. Here is a list of all changes based on both reviewers and some minor changes for better understanding:

omment / Answer to gi-2016-30-RC1.pdf

1) Section 2, paragraph 5: The discussion on observing ge- ometry is confusing as it mixes east, west, and also mentions north. The "north" may be a type for west?

»> Indeed, this is a typo and shall be "west" -> Changed

2) Section 2, paragraph 6: Please elaborate on the geometric vs physical biases, what

is the detection system bias - how is it different than physical biases.

»> Our sentence was misleading. We said that only 2 effects are presents but we mentioned 3: geometrical, physical, detection system. The geometry (pointing etc.) is a part of the detection system. Thus I deleted it from the first sentence. I also added a brief explanation for the physical and technical bias.

3) Section 3.2, paragraph 8: Photometric calibration is only done when the pointing has changed? This calibration should be done more often. Have you seen any change in photometric calibration with time?

»> We have not checked this, it is an excellent idea for a future paper.

4) Section 3.3.2, paragraph labeled (b): Use the term vignetting to describe the drop-off in brightness towards the FOV edges.

»> We actually disagree. According to optics books vignetting is a drop-off caused by e.g. a mechanical stop in the incoming light beam. But even in absolutely unobstructed light paths the light is spread out over more pixel away from the optical axis, is just goes with the tangent of the angular distance to the center. Vignetting only covers half of the drop-off. I recommend to leave the term as is. Since this term seems to be unclear to many people I suggest to add after 'drop-off' (caused by both vignetting and the tangent-effect at larger distances to the center of the field of view).

5) Section 3.3.2, paragraph labeled (d): Preferable to say "the noise statistics are estimated from a sequence of dark frames (no light entering the sensor system)".

»> Done / Changed accordingly

6) Section 3.3.3, paragraph labeled (c): One should determine or state positively, if 3rd order is good enough for the given lens and FOV. Rather than use the term "may" which leaves open what order is necessary.

»> This should be addressed in the section 'conclusions'. We added the following text

in Section 6, p. 34, after the sentence 'The possible rescaling from physical pixels to the PAL format (Section 3.3.3 (e)) will also contribute to this result.': 'As can be seen in Figure 4, the deviation of the expected star positions to the real positions, based on the 3rd-order polynomial fit, stays around or below 0.2' until abut 175 pixels distance to the center of the field of view. For larger values the deviation starts to increase linearly. One of the possible reasons for this could be that the 3rd order is not enough. We did not check whether a 4th order fit would produce a better result, this will be future work.'

7) Section 3.3.3, paragraph labeled (d): On the last sentence, doesn't the astrometric measurements affect the quality of the fit and not vice versa. Or is it because you adjust the fit and spacing that you are making this statement. Or are you referring to the fit parameters which are the solved-for astrometric parameters (not measurements). Please clarify.

»> "... quality of the astrometric measurements" refers to the deviation between fitted function (linear or quadratic for the positions) and the actual measured photometric center of each meteor video frame. Using a higher order polynomial would improve the deviation or "astrometric measurements" and also the derived speed of the meteor. I changed to text accordingly since in this paragraph we mixed the words and descriptions referring to position and velocity determination too much.

8) Section 3.3.4, paragraph 1: Clarify "random scatter". Caused by what ?

»> Probably the word "random scatter" is misleading. Random errors and systematic errors are both parts of the observational error. System errors include e.g. a causes deviation of the astrometry caused by the lens or lens-deformation that is temperature depending. "Random scatter" or, here replaces by the word "Random error", is a pure statistical effect and is caused by natural / inherent fluctuations in the measurements process (example: the number of photons that reach a pixel is described by the Poisson distribution and is independent from the used instruments).

9) Section 5, paragraph 6 (after Figure 18): Have you removed shower meteors,

Toroidal meteors, and Helion meteors from the analysis as it pertains to the conclusion drawn

»> We did not remove any sporadic sources or showers, only the first and last velocity value due to the earlier mentioned effect. The significant majority of our sporadic meteors are Anti-Helion and Apex meteors. The angular distance between camera pointing and Apex / Anti-Helion Source correlates best for our described biases. Adding an additional data reduction step in the paper would not lead to a better understanding. We wanted to show the significance of this effect by using the complete dats set.

10) Section 6, paragraph 2: Have you seen seasonal changes - e.g. from long term average temperature swings ?

»> In this paper we did not analyzed this effect. We had some discussion about this topic. It would be a nice additional analysis to show it at the upcoming International Meteor Conference.

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Comment / Answer to gi-2016-30-RC2.pdf

1) please clarify limitations of simulation Monte Carlo

»> The focus of our work is the bias analysis. We mention the Monte-Carlo method only once on page 15. I added a reference to an International Meteor Conference Proceeding Paper, where the procedure is described in more detail.

2) clarify future work

»> Added at the end of section 6. One open point, as already asked by Mr. Gural are the effects of temperature fluctuations. Furthermore scientific projects need to consider the shown bias effects, if proper and un-biased distributions have to be derived.

3) clarify how different the biases are

»> This comment fits partly with the comment from Peter Gural. We made changes accordingly.

4) to investigate possible detection time correlations what coefficient has been used? clarify please. goodness-of-fit is only used to make sure the existence of these dependences

»> To clarify the correlation visually for the reader we inverted the y axis of figure 16 and 17. The angular distance values decrease from bottom to top. The correlation between the number of detections vs. the angular distance is now more present and clearer for the reader.

##

Additional minor changes:

Page 2:

Old: The distortion of the camera system can be neglected.

New: The distortion of the video images can be neglected.

Explanation: The distortion affects directly the images and is a consequence of the optical system.

Page 5:

Old: The complete content of an information file is, for each frame where the meteor was detected: frame number, precise time taken from the computer clock, stellar magnitude of the event, position of the photometric center in coordinates relative to the detector and in celestial coordinates, and fitted coordinates as described in the following paragraph. An example information file can be found in Koschny et al. (2013).

New: The complete content of an information file is, for each frame where the meteor was detected: frame number, precise time taken from the computer clock, magnitude of

the event, position of the photometric center in coordinates relative to the detector and in celestial coordinates, and fitted coordinates as described in the following paragraph. An example information file can be found in Koschny et al. (2013).

Explanation: Changed "stellar magnitude" to "magnitude" (redundant)

Page 5 / 6:

Old: This noise can be quantified by obtaining images with no light entering the system.

New: The noise statistics are estimated from a sequence of dark frames (no light entering the sensor system).

Explanation: In astronomy the word "dark images / frames" describes the "old" sentence and appears clearer.

Page 6:

Old: A timing error of 1 s would correspond to a position error in Right Ascension of 1/4’ at the celestial equator.

New: A timing error of 1 s would correspond to a position error in Right Ascension of 1/4’.

Explanation: Reduandancy.

Page 15:

Changed resolution to 384 pixel x 288 pixel due to a typo.

Page 27 + 28: Inverted the left side y axis of both figure. The correlation appears now way clearer (mentioned in the anonymous review)

Page 28:

Old: The Antihelion direction rises...

New: The Antihelion point rises...

Explanation: A direction cannot "rise above" a horizon.

Please also note the supplement to this comment:
http://www.geosci-instrum-method-data-syst-discuss.net/gi-2016-30/gi-2016-30-AC1-supplement.pdf

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