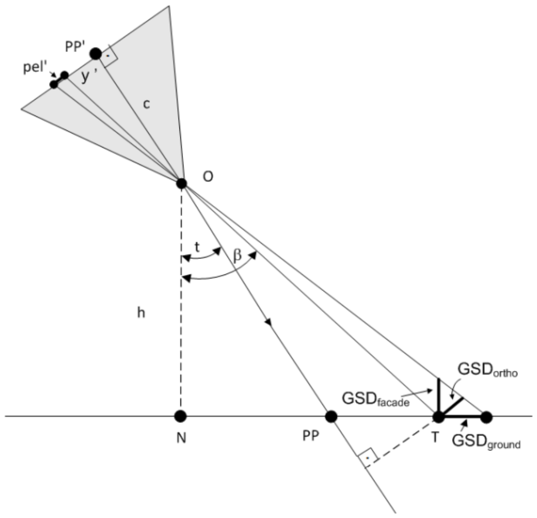
**Comments to the "ASPRS Draft Accuracy Standard" (pdf-version) of Joachim Höhle**

**Page 1, line 27:**




The GSD depends also from the nadir distance (t) of images, the position in the image (y'), the elevation differences in the terrain, and the place at objects (façade, roof). We have to distinguish between $GSD_{ground}$, $GSD_{façade}$, and $GSD_{ortho}$ (cf. Figure 1).

The values for GSD can differ very much in cities and mountains. It should be added that the GSD is defined for an average terrain elevation and orthogonal to the optical axis of the camera.

**Page 2, line 41:** The reference points should have a "higher" accuracy. Such a specification is very vague. It could be specified with a factor or a per cent value. For example, the accuracy of the reference value should be a third of the data to be assessed or the total accuracy should not exceed 5% of the accuracy of the data to be assessed. Expressed in a formula with standard deviation: $(\sigma_{ref})^2 + (\sigma_{data})^2 < (1.05)^2 * (\sigma_{data})^2$.

**Page 2, line 57:** In addition to RMSEx, RMSEy the systematic shifts in Easting and Northing of the orthophoto should be assessed. The shift values should not be influenced by blunders or a non-normal distribution of the errors.

Orthophotos are usually classified how the objects above terrain are corrected and if hidden parts are supplemented by adjacent images (true orthophotos, correction for important objects only (e.g., bridges), no corrections). The position of check points should be mentioned (on the ground or not).

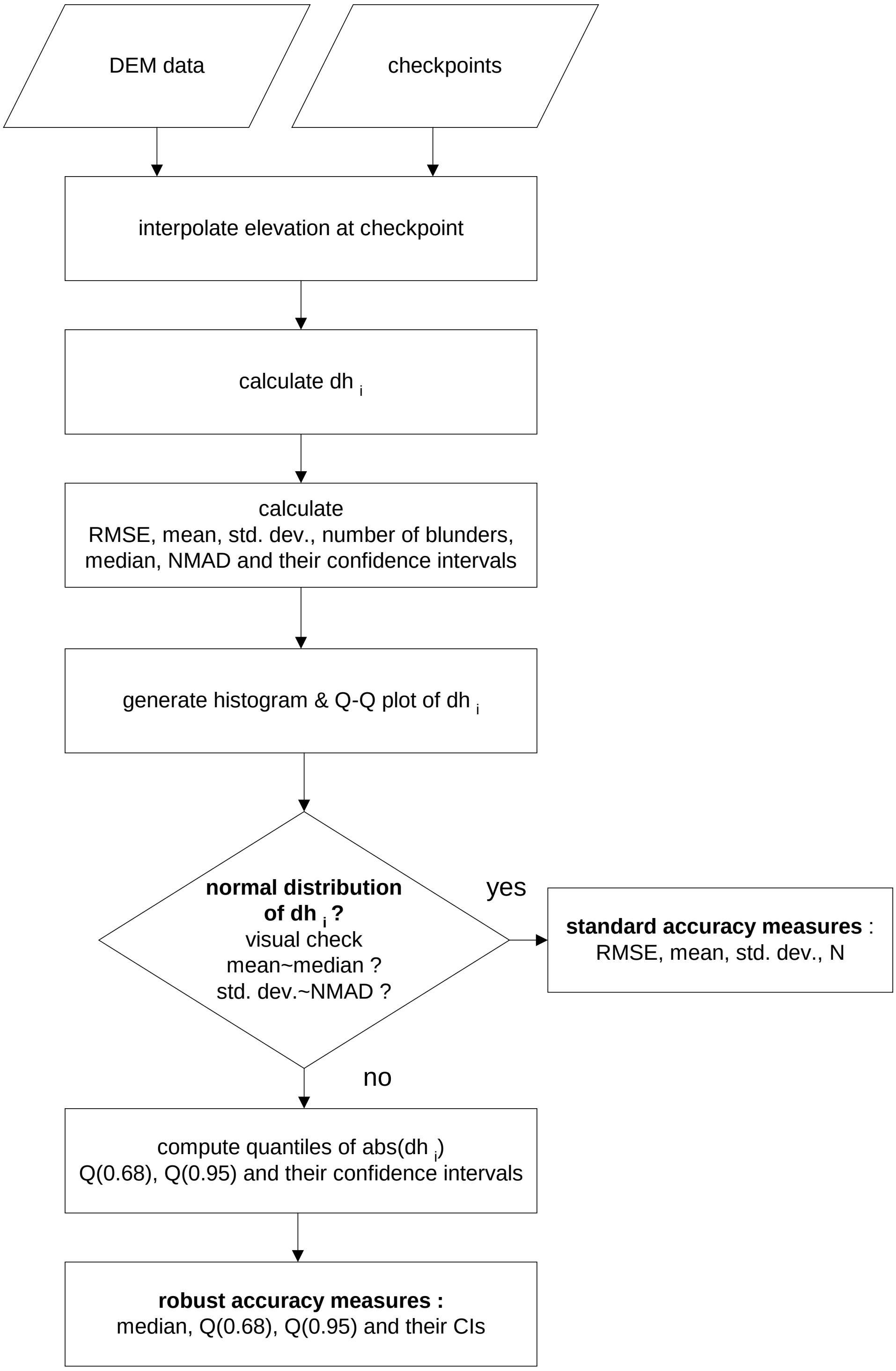
**Page 3, line 78:** The classification of maps by map scale is challenged. It is the size of the smallest map objects, the resolution of the applied imagery (GSD) and the degree of generalization which distinguishes map data bases. The content of the map data base can be plotted in different scales. Reliable values for the systematic shifts in Easting and Northing of the map should be assessed in addition.

**Page 5, line 138:** The check points for relative vertical accuracy should be "3 m away from any vertical artefact or abrupt change in elevation". The distance will change with the flying altitude due to IMU errors. The value should therefore be related to the flying altitude. The value of 3 m is rather big which indicates that horizontal errors will cause vertical errors. The horizontal errors should therefore be accessed in all DEM surveys.

**Page 10, foot note:** Error in formula $NPD=1/NPS^2$ (should be square NPS)

**Page 13, line 382:** The efforts for using the metric system could also be applied to the area measures ($km^2$ instead of square miles).

**Page 16, line 484:** “Vertical errors tend to approach a normal distribution (bell curve) in open, non-vegetated terrain with a large number of check points”. I think that DEM data of all terrain types should be tested for normal distribution. If the distribution of errors is not normal then robust accuracy measures have to be applied. Such accuracy measures are the Median, the Normalized Absolute Deviation (NMAD) and the 95% quantile/percentile. The decision which accuracy measures (standard or robust) are applied can be derived from a histogram or QQ-plot (cf. attached diagram). More details can be found in [1] and [2]. All of the accuracy measure could be supplemented with a 95% confidence interval (CI) in order to document their uncertainty. Programs in “R” will make this possible and they are contained in [2].



**Page 16, 492:** “With lidar and IFSAR sensors, system calibration and boresighting are used to control horizontal accuracy.” I believe that the horizontal accuracy of such DEM data has always to be assessed and the results should be documented. Relevant methods exist and are described in [2] and [3].

References:

[1] Höhle, J., Höhle, M., 2009. Accuracy assessment of digital elevation models by means of robust statistical methods, ISPRS journal of photogrammetry and remote sensing, 64, 398-406

[2] Höhle, J., Potuckova, M., 2011. Assessment of the quality of digital terrain models, Official Publication of EuroSDR No. 60, European Spatial Data Research, Frankfurt/M., 85 p.

[3] Höhle, J., 2013. Assessing the positional accuracy of airborne laser scanning in urban areas, The Photogrammetric Record, 28(142): 196–210