The digital zenith camera VESTA (Vertical by STars) was designed by the Institute of Geodesy and Geoinformatics (GGI) of the University of Latvia and completed in 2016. Since then 395 terrestrial vertical deflection measurements were done in the territory of Latvia. These observations were post-processed by the GGI developed software and the accuracy was evaluated at 0.1 arc seconds. Terrestrial observations were compared with global geopotential models, e.g., GGM+ and EGM2008. The results show a better correspondence with GGM+ model by evaluating the standard deviation: 0.314 and 0.307 arcseconds for ξ and η components respectively in comparison to 0.346 and 0.358 arcseconds for ξ and η components for EGM2008 model. The comparisons of average and minimum/maximum differences are introduced in this study for better evaluation of the results. Moreover, vertical deflections have been used as additional terrestrial data in DFHRS (Digital Finite-element Height Reference Surface) software v. 4.3 in combination with GNSS/levelling data (B, L, h[H]) and global geopotential model EGM2008 for the quasi-geoid improvement (www.dfhrs.de). The results of the computed quasi-geoid models using different types of data are introduced in this research, representing several solutions, as well as these solutions are compared with the national quasi-geoid model LV'14. In the middle of 2019, the new upgraded version of digital zenith camera was developed by the scientific staff and the accuracy of the measurements of improved camera was evaluated at 0.05 arcseconds, which is two times better than previous one. The improvements of new digital zenith camera are also discussed in this research. It is important to point out that according to our observations the application of digital zenith camera reveals a new capabilities for studies of mass distribution beneath earth.

**Table 1. The evaluation of Quasi-geoid (m)**

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>max</th>
<th>Avg</th>
<th>Stdev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quasi-geoid</td>
<td>-0.032</td>
<td>0.031</td>
<td>0.012</td>
<td>0.014</td>
</tr>
</tbody>
</table>

**Table 2. The comparison of field VD with derived VD from DFHRS and EGM2008 (arcsec)**

<table>
<thead>
<tr>
<th></th>
<th>Xi</th>
<th>Eta</th>
<th>Xi</th>
<th>Eta</th>
<th>Xi</th>
<th>Eta</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFHRS</td>
<td>-0.190</td>
<td>-0.348</td>
<td>0.162</td>
<td>0.216</td>
<td>0.033</td>
<td>0.041</td>
</tr>
<tr>
<td>EGM2008</td>
<td>-1.128</td>
<td>-0.939</td>
<td>1.669</td>
<td>2.491</td>
<td>0.256</td>
<td>0.252</td>
</tr>
</tbody>
</table>

**Fig. 1. The Digital Zenith Camera**

**Fig. 2. The interface of the VD processing software**

**Fig. 3. The location of GNSS/levelling points and DoV**

**Fig. 4. The comparison of terrestrial VD and VD derived from EGM2008**

**Fig. 5. Upgraded DZC**

**Fig. 6. Fig. 7. Variations of xi and eta component estimated using moving time windows of different (12 h measurements)**

**Fig. 8. The comparison of national LV’14 and GGI model**

**Fig. 9. VD variations for different width of moving time window**

**Fig. 10. Quasi-geoid model for Latvia**

**IMPROVEMENTS:**
- Elaboration of measurement methodology,
- Measurement control software corrections and complements,
- Data processing improvements and automation,
- Transition to GAIA data release 2 star catalog,
- Revision of mechanical design, development of a new model,
- Currently 4 cameras are manufactured

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