3. CALIBRATIONS

We transform the instrumental v and i magnitudes into standard Johnson-Kron-Cousins photometric system (Landolt 1992) V and I, using the Photometric Standard Fields of Peter Stetson available via on line[5]. We could not transform our r photometry to the standard system because there are not standard stars available in this filter. A plot of the RMS of the mean magnitude vs. the mean magnitude, shows that we achieved accuracies better than 20 mmag scatter in the magnitude rank 14 to ≈18.5 mag, and ≈6–10 mmag photometry at the bright end in the filter V. In the filter R we achieve ≈8–12 mmag photometry at the bright end.

4. FINDING VARIABLE STARS

In the search of variable stars, we used methods that allows to make automatic or semi-automatic selection of variable stars candidates. One such method is the phase dispersion minimization (PDM) method, in which probe periods are used to phase the light curve, and selects the one that produces the minimum dispersion parameter (SQ). Stars with a smaller SQ are good candidates to be variables. Other method, uses the errors diagram and the fact that a stars that is changing its brightness will have a high RMS magnitude deviation for its given mean magnitude. Yet another method uses the difference image produced by `DanDIA` and by converting each difference image D_{kij} to an image of absolute deviations in units of sigma $D\prime_{kij} = |D_{kij}|/\sigma_{kij}$ and then constructing the sum of all such images $S_{ij} = \sum_k D\prime_{kij}$ for each filter, one can identify candidate variable sources as PSF like peaks in the image S_{ij}.

5. FOURIER DECOMPOSITION AND PHYSICAL PARAMETERS

To find the physical parameters of the RR Lyrae, we first make a Fourier fit of the light curve, which has the mathematical form

$$m(t) = A_0 \; + \; \sum_{k=1}^{N} A_k \; \cos\left(\frac{2\pi}{P} \; k \; (t - E) \; + \; \phi_k\right), \tag{1}$$

where $m(t)$ are the magnitudes in the t time, P is the period of the light curve and E is epoch maximum. Then, using the amplitudes A_k and the phases ϕ_k we can find the Fourier parameters $\phi_{ij} = j\phi_i - i\phi_j$ and $R_{ij} = A_i/A_j$. Combining these parameters with calibrations available in the literature, we find the metallicity [Fe/H], absolute magnitude, luminosity, effective temperature and distance of each individual RR Lyrae star and hence the mean values for the globular cluster. Details on the calibrations employed, their zero points adjustments and a complete report on the results for NGC 6981 can be found in our paper Bramich et al. (2011). The interested reader can find detailed information about detection and characterization of variable stars in globular clusters and the use of these results to estimate the parameters of the host clusters in some of our previous works (e.g., Arellano Ferro et al. 2010 (NGC 5053); Arellano Ferro et al. 2008 (NGC 5466), and references therein).

6. RESULTS

Using the techniques described above we found 11 new RR Lyrae variables, 3 new SX Phe variables, confirm the variable nature of another 29 variables already reported as variables and refined their ephemerides. We have shown that 20 stars previously reported as variables or suspected of variability, are not varying within the uncertainties of our photometry. We found the mean values $[\mathrm{Fe/H}]_{\mathrm{ZW}} = -1.48 \pm 0.03$, $M_V = 0.623 \pm 0.002$, $\log(L/L_\odot) = 1.660 \pm 0.001$, $T_{\mathrm{eff}} = 6418 \pm 10$, a distance modulus of $\approx 16.117 \pm 0.047$ which corresponds to a distance of $\approx 16.73 \pm 0.36$ kpc for the RR0.

In the paper Bramich et al. (2011) we also provide astrometric positions of all known variables with an accuracy of ∼0.03 arcsec which offer an epoch for mid- and long-term astrometry of the cluster.

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