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Abstract. A distance is found for the W UMa type binary U Pegasi, with a newly modified version of the Wilson-Devinney program (W-D) that makes use of the direct distance estimation (DDE) algorithm. The reported distance of $d = 123.6$pc is an average based on solutions for B and V data and a primary star temperature of 5800K. Standardized light curves (not differential), radial velocities, and a spectroscopic primary star temperature are input to the program. Differential corrections were performed for each light curve band along with the velocities for two primary temperatures that span 100K. $\text{Log}_{10}d$ is a model parameter like many others that are adjustable in W-D. The eclipsing binary distance agrees with the *Hipparcos* parallax distance and is more precise.

1. Analysis

Light curves of the W-type W UMa eclipsing binary U Pegasi by Zhai et al. (1984) were converted from differential magnitudes to the standard B and V systems by addition of the comparison star's magnitudes, $B = 10^m.092 \pm 0^m.026$, $V = 9^m.488 \pm 0^m.021$ (Kharchenko 2001) for BD+14°5078. Both U Peg components are of type G2 (Lu 1985), and an adopted primary star temperature of 5800K was rounded from two values in Cox (2000). Subsequent work by Zhai et al. (1988) refined several velocity points that occur near conjunction. The light/velocity data were solved simultaneously for distance and other parameters by a version of the Wilson-Devinney (W-D) Differential Corrections (DC) program that contains the direct distance estimation (DDE) algorithm.

The Zhai et al. (1988) parameters were initial input. However the linear ephemeris (Zhai et al. 1984) was independently adjusted to improve fits to V band light curves and velocity curves, which are separated by 6 years. A solution with primary temperature 5900K was also made to allow parameter interpolation in T_1 by readers. Adjusted parameters were inclination (i), secondary temperature (T_2), semi-major axis (a), potential (Ω_1), systemic velocity (V_γ), mass ratio ($q = \frac{M_2}{M_1}$), and distance ($\log_{10} d$). Initial solutions that adjusted third light found ℓ_3 to be insignificant, so ℓ_3 was fixed at zero. The parameters were split into two DC subsets to reach the solutions of Table 1.

2. Final Remarks

The theory of the DDE algorithm, with overviews of simulations, is in Wilson (2008). As applied to 1978 Zhai, et al. light curves and 1984 Lu velocity data for U Peg, DDE yields respective B, V distances of 121.6 and 125.5 pc if T_1 = 5800K. The formal errors are smaller than the spread, so calibration errors probably account for most of the modest disagreement. Hipparcos parallaxes, as revised by van Leeuwen (2007), span 122 to 175 pc according to the reported 1σ errors. Our model light curves might fit the data better if spots were modeled as in Djurašvić et al. (2001), but derived distance typically is not much affected by such refinement. Although period variations have been linked to a third body by several authors, our solutions indicate that ℓ_3 is unlikely to affect distance estimates significantly. Another set of distances will be based on light curves by T. Pribulla (Pribulla & Vaňko 2002) and published elsewhere.

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Table 1. Solutions for U Peg

Parameter	$B(T_1 = 5800\text{K})$	$V(T_1 = 5800\text{K})$	$B(T_1 = 5900\text{K})$	$V(T_1 = 5900\text{K})$
$i[°]$	75.26 ± 0.08	75.44 ± 0.08	74.92 ± 0.09	75.35 ± 0.12
T_2[K]	5637 ± 4	5622 ± 8	5738 ± 8	5619 ± 7
$a[R_\odot]$	2.56 ± 0.02	2.54 ± 0.02	2.57 ± 0.02	2.56 ± 0.02
V_γ [km s^{-1}]	30.9 ± 0.8	30.7 ± 1.0	31.0 ± 0.9	31.2 ± 0.9
Ω_1	6.294 ± 0.012	6.207 ± 0.025	6.256 ± 0.009	6.201 ± 0.013
$q = M_2/M_1$	2.839 ± 0.009	2.763 ± 0.019	2.824 ± 0.006	2.772 ± 0.010
d[pc]	121.6 ± 1.0	125.5 ± 1.0	129.3 ± 1.0	132.2 ± 1.0
R_1/a (pole)	0.2809 ± 0.0011	0.2819 ± 0.0023	0.2826 ± 0.0008	0.2830 ± 0.0012
R_1/a (side)	0.2938 ± 0.0013	0.2947 ± 0.0028	0.2958 ± 0.0010	0.2961 ± 0.0015
R_1/a (back)	0.3327 ± 0.0050	0.3327 ± 0.0050	0.3358 ± 0.0018	0.3352 ± 0.0027
R_2/a (pole)	0.4506 ± 0.0008	0.4474 ± 0.0018	0.4514 ± 0.0006	0.4490 ± 0.0010
R_2/a (side)	0.4483 ± 0.0012	0.4803 ± 0.0025	0.4854 ± 0.0009	0.4824 ± 0.0013
R_2/a (back)	0.5131 ± 0.0015	0.5089 ± 0.0032	0.5148 ± 0.0011	0.5114 ± 0.0017

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