COMMON AND ELITE VARIABLES, THEN AND NOW

DORRIT HOFFLEIT
Yale University Observatory
New Haven, CT 06511

Abstract

When the AAVSO was founded, variables seemed to be a rare class of stars, and intrinsic variables with very small amplitudes were practically unknown. Now, thanks to photoelectric photometry, 44% of the known variables among the naked eye stars are variable by less than 0.1 magnitude, and only 22% by over 0.5 magnitude. Thus the most common types known in 1911 now constitute an elite minority.

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About the time the AAVSO was founded, in 1911, photoelectric photometry was in its early infancy. In 1910, the pioneering expert Joel Stebbins, then at the University of Illinois, was experimenting with a selenium cell for measuring the relative brightness of two stars. The first application of a photo-cell to variable star photometry was carried out in 1913 by Guthnick at Berlin and by Meyer and Rosenberg at Tubingen, Germany. Soon Guthnick and Prager measured some spectroscopic binaries which thereby proved also to be eclipsing binaries of small amplitude. But early instruments were difficult to use and progress was slow. Except for a small number of photoelectric experts, variable star photometry was carried out predominantly by visual and photographic techniques. Any star appearing to vary by less than 0.5 magnitude was suspected of exhibiting only spurious accidental errors of measurement. The few stars whose small amplitudes could be confirmed were considered rare novelties.

By 1962, when the third edition of the _Bright Star Catalogue_ was being compiled, photoelectric techniques had become more widely applied. At that time 17% of the confirmed variables among the bright stars showed amplitudes less than 0.1 magnitude, 24% between 0.1 and 0.5 magnitude, but the great majority, 59%, still showed amplitudes larger than 0.5 magnitude-- the lower limit for visually or photographically measured variables to be accepted into the _General Catalog of Variable Stars_ unless their periods had already been determined.

But now the situation has changed drastically. In the forthcoming fourth edition of the _Bright Star Catalogue_, the total number of both confirmed and suspected variables (over 2000) has doubled since 1964, and the numbers of confirmed and named variables increased more than three-fold (from about 260 to over 800). Of those whose amplitudes have been published, 44% vary by less than 0.1 magnitude, 34% from 0.1 to 0.5 magnitude, and only 22% by 0.5 magnitude or more. Moreover, many bright stars reveal spectral characteristics closely resembling those of the low-amplitude intrinsic variables. Consequently, the percentage of low-amplitude variables is likely to increase steadily as more and more AAVSO observers are acquiring photoelectric equipment and are pursuing promising stars with peculiar spectra (see References).

The majority of AAVSO observers, however, will rightfully continue visual monitoring of the higher-amplitude stars - stars that by virtue of their relative cosmic scarcity and venerable observing status now constitute the elite among variable stars. Only for these is it currently possible to study period and light curve changes over an observational span exceeding, in many cases, the age of the AAVSO. Such changes, especially for the Mira stars, can be properly interpreted theoretically only when a very long time base of observations has become available. The value of the older observations continues to increase as newer observations are being added.

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SOME THOUGHTS ON THE ANALYSIS AND INTERPRETATION OF LIGHT CURVES, PART II: PERIODICITIES

LEE ANNE WILLSON
Erwin W. Fick Observatory
Iowa State University
Ames, IA 50010

Abstract

Part I of this series showed the consequences of the fact that magnitudes are logarithmic quantities. In this contribution the question of variable star periods is discussed, in particular the cases where multiple periods and/or period changes are present.

The O-C diagram can be a powerful tool for determining periods, period changes, and even the presence of multiple periods. Some superficially similar light curves can easily be distinguished by comparison of their O-C diagrams: examples include "AM" vs. "FM" modulation.

Fourier analysis is the classic method for establishing the presence of periodicities. This method is powerful, but has the drawback that if the light curve is not strictly sinusoidal, the Fourier results will include extra periods to account for the shape of the light curve. Here, the results may depend on whether the magnitude variation or the flux variation is analysed.

Recently a number of relatively straightforward techniques for determining the periods present in a varying source have become popular among astronomers. These techniques include "phase dispersion minimization" and "auto-correlation." The basic assumptions of these techniques are described, examples shown, and further references given.

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