# Fourier Analysis of Line-Profile Variations: Toward Stellar $m - \nu$ Diagrams?

W.J. Merryfield[1], E.J. Kennelly[2]

[1] *University of Victoria,* [2] *University of British Columbia*

**Abstract**

Numerous rapidly rotating $\delta$ Scuti stars exhibit variable line profiles containing traveling subfeatures [1]-[2], which may be signatures of nonradial pulsations having relatively high azimuthal order $|m|$. We describe a procedure whereby a time series of spectral line profiles is Fourier analysed both in time and in a wavelength variable that is presumed to correspond to azimuthal position $\phi$ on the star. What such an analysis can tell us is examined by analysing artificially-generated data. For an ideal example in which $\sin i = 1$ and a single mode having $\ell = -m = 10$ is present, the two-dimensional Fourier transform yields a power spectrum in frequency $\nu$ and an apparent azimuthal order $\hat{m}$ that provides a good indication of the actual $\nu$ and $m$. Such a straightforward interpretation is also possible when $\sin i < 1$, and when multiple sectoral modes ($\ell = |m|$) are present. For tesseral modes ($\ell > |m|$), $\hat{m}$ may correspond more closely to $\ell$ than to $m$.

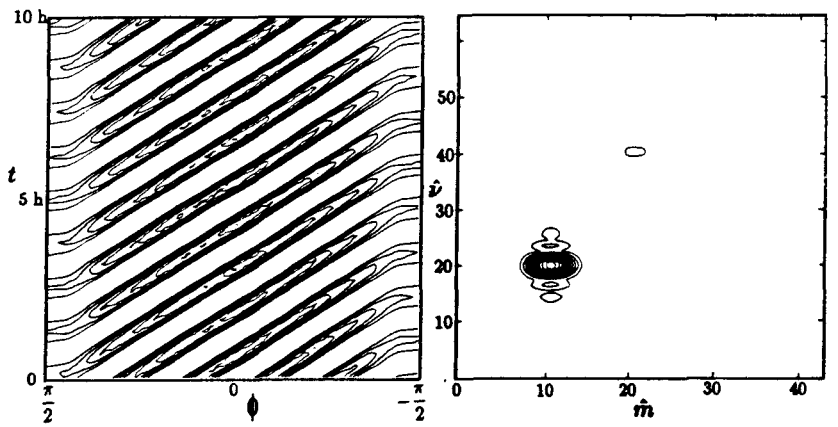


**Figure Caption.** (a) Residual line-profile variations for a ten-hour observation when a single mode is present having $\ell = -m = 10$, $\nu = 20$cycles d$^{-1}$, and radial velocity amplitude $V_r = 2.5$ km s$^{-1}$; (b) Two-dimensional Fourier transform of (a). The position of the primary peak corresponds closely to the input values of $m$ and $\nu$.

## References:

Walker, G.A.H., Yang, S. & Fahlman, G.G. 1987, *Astrophys. J.* **320**, L139.
Kennelly, E.J., Yang, S., Walker, G.A.H. & Hubeny, I. 1992, *P.A.S.P.* **104**, 15.



https://doi.org/10.1017/S0252921100117154 Published online by Cambridge University Press