FMN011 Exam — Computational Part II
Finding the line strength of stars for an astronomer

Lund, April 2012

Please read the detailed instructions on the course webpage.

Hand in the report on paper (not via e-mail) during the break (16:00-16:15 hours) at the lecture on Monday, May 14, 2012, or else place it in the box marked FMN011 at the bottom of the shelf located at the entrance of the right-hand side corridor (MH, ground floor). The reports will be collected at 17:10 hours sharp on Monday, May 14, 2012. Any report handed in or placed in the box after this time will not be accepted.

Real-world problems are accompanied by complexities and ambiguities. An engineer working in industry should be able to recognize when the use of numerical methods is necessary, and to apply them appropriately. He or she should also understand the difficulties, limitations and errors that may appear.

In this project you will learn by doing. The assignment is deliberately open-ended. There is no unique manner of solving the problems encountered. You will have to make decisions about how to deal with each particular problem. Be sure to point this out in your report. Explain what were the alternatives and why you chose the one you did. If possible, try exploring several different choices and see how they influence your final outcome. You will have to decide when you have obtained a satisfactory answer, and you will be graded based on both how thorough your investigation was as well as how accurate your answers were. Make good use of plots and tables to illustrate your explanations and results.

Astronomers analyze the intensity of light from stars, splitting it up into the different frequencies. The function of *relative intensity* (in $\mathrm{W/m^2\ Hz}$) vs. frequency (in Hz) is called the *spectrum* of a star. Light from the dense part of the star produces a continuous curve, but the gas that surrounds the star produces a discrete spectrum, or *spectral lines*. Every chemical element produces a specific set of lines at fixed frequencies, so by identifying the spectral lines, the astronomer can find out the composition of the star. If the gas is cool it will absorb light, and if it is hot it will emit light.

You can read more about star spectra at

`http://www.astronomynotes.com/light/s4.htm` and

`http://www.astronomynotes.com/light/s5.htm`

The Task

You work for an astronomer that wants to analyze a certain star by studying its spectral data. This data is contained in the Excel file `spectrum.xls` which can be downloaded from our course website. The data shows a continuous spectrum from the surface of the star, plus six spectral lines (three absorption lines and three emission lines). Your boss needs you to find the total intensity for each line, or *line strengths* (in W/m^2). To do this you need to integrate the relative intensity over the frequency, that is, calculate the area of each peak.

You can read further about line strengths of stars at

`http://cas.sdss.org/dr6/en/proj/advanced/spectraltypes/`

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