Introduction to analysis of astrophysical time series - course description

General information

Course name	Introduction to analysis of astrophysical time series
Course ID	13.7-WF-FizP-IAATS-S17
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	First-cycle studies leading to Bachelor's degree
Beginning semester	winter term 2018/2019

Course information

Semester	5
ECTS credits to win	3
Course type	obligatory
Teaching language	english
Author of syllabus	• dr Krzysztof Maciesiak

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	15	1	-	-	Credit with grade
Class	15	1	-	-	Credit with grade

Aim of the course

Ability to analysing time series based on pulsar observations. Use of Fourier transform and interpretation of results from carrying out time series analysis.

Prerequisites

Finished courses: Basic programming.I ntroduction to higher physics and mathematics. Mathematical analysis.

Scope

LECTURE:

- Pulsar emission as a numerical time series.

- Spectral analysis of pulsar emission.

- Fourier series.

- Finding of amplitude and power spectrum of periodic series.

- Application of Fourier transform to calculation of amplitude and power spectrum of chosen periodic series.

- Spectral analysis of non-periodic pulsar emission.

- Spectral analysis of random signal from pulsars.

- Numerical methods of spectral analysis of pulsars:

a) Rules of analogue-digital signal processing; digital filtering

b) Discrete Fourier transform – DFT

c) Fast Fourier transform – FFT

d) Numerical calculation of spectral density

e) Numerical calculation of the cross-spectral density

- Special methods of the spectral analysis of signal from pulsars.

CLASS:

- Working and usage of Fourier transform and fast.

- Time series simulations.

- Searching for periodicities in a sample of real and simulated data using computer programme.

- Spectral analysis of pulsar emission.

a) Fourier transform

b) Calculation of amplitude and power spectrum of periodic series

c) Application of Fourier transform to calculation of amplitude and power spectrum of chosen periodic series

- Spectral analysis of non-periodic pulsar emission.

- Spectral analysis of random signal from pulsars.

Teaching methods

Lecture, calculus exercises, writing computer programmes.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Student is able to: define amplitude spectrum and find a periodicities in a time series, power spectrum, spectral density, cross-spectral density		• a quiz • an exam - oral, descriptive, test and other • an ongoing monitoring during classes	• Lecture • Class
Student should be able to use techniques used in astronomy according to time series analysis e.g. Fourier transform or expansion of the time series into Fourier series. Student knows limitations coming out from used methods or computer programmes		• a quiz • an exam - oral, descriptive, test and other • an ongoing monitoring during classes	• Lecture • Class

Assignment conditions

Class: pass all tests and all programming tasks (project).

Lecture: Exam allowed only with a positive class grade. Oral exam. Pass condition – satisfactory grade.

Final grade: 50% class grade+ 50% exam grade.

Recommended reading

[1] E. Ozimek, *Podstawy teoretyczne analizy widmowej sygnałów*, PWN, Warszawa-Poznań, 1985.

[2] L. H. Koopmans, *The spectral analysis of time series*, Academic Press, New York, 1974

Further reading

[1] С. Я. Адзерихо, *Введение в линейную алгебру, теорию поля и ряады фурье*, Издательство "Вышейшая школа", Минск, 1968.

Notes

Modified by dr hab. Piotr Lubiński, prof. UZ (last modification: 01-08-2018 15:19)