Turning images into value through statistical parameter estimation

WOG Meeting on Bayesian Inference

Groene zaal, B1.1, Universiteit Hasselt
Martelarenlaan 42, Hasselt

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Research Foundation Flanders
Opening new horizons

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Scientific program

9:30-10:00		**Welcome with coffee & tea**
10:00-11:00	Christel Faes	Tutorial on Bayesian inference
11:00-11:30		**Coffee & tea**
11:30-12:30	Christel Faes	Tutorial on Bayesian inference
12:30-14:00		**Lunch & poster session**
14:00-14:25	Cole Johnston	Bayesian modelling in stellar astrophysics: forward seismic modelling
14:25-14:50	Lewys Jones	Using Bayesian concepts to improve the reliability of 3D atomic metrology
14:50-15:15	Quinten Collier	A Bayesian estimation with shrinkage prior approach to the DKI-FWE model parameter estimation problem
15:15-15:45		**Coffee & tea**
15:45-16:10	Dirk Poot	Towards Bayesian image reconstruction of quantitative MRI
16:10-16:35	Jarmo Fatermans	Bayesian model-fitting to detect atomic columns from electron microscopy images
16:35-17:00		**Group discussion, wrap up & looking forward**
17:00-18:00		**Reception**

Abstracts

Bayesian modelling in stellar astrophysics: forward seismic modelling – Cole Johnston

Forward modeling techniques in stellar astrophysics are in need of an updating. To this end, we will develop and test a new framework for the forward seismic modeling of gravity-mode pulsating B-type stars comparing the benefits and limitations of introducing a Bayesian framework into the modeling scheme. This will focus on a hound-and-hare exercise applied with realistic observational errors.

Using Bayesian concepts to improve the reliability of 3D atomic metrology – Lewys Jones

In recent years much progress has been made in understanding both the precision and accuracy of experimental annular dark-field images from the scanning transmission electron microscope (ADF-STEM). A special interest using this type of data is atom-counting within mono-metallic nanoparticles, where the number of atoms in individual atomic-columns can be used to rebuild the 3D structure. However, using Bayesian methods, to consider the whole ensemble of column observations, we can retrieve more realistic nanostructures with an overall lower system energy.

A Bayesian estimation with shrinkage prior approach to the DKI-FWE model parameter estimation problem – Quinten Collier

The "Diffusion kurtosis imaging with free water elimination" (DKI-FWE) model was recently introduced to separate the tissue and free water signal contributions in diffusion MR imaging. Although DKI-FWE provides clinically interesting diffusion metrics, the ill-conditionedness of the model parameter estimation problem makes its practical use limited as conventional estimation techniques are unable to provide reliable parameter estimates. We therefore propose to use a Bayesian estimation approach with a shrinkage prior (BSP). For this prior, only the Gaussian shape is imposed on the model parameters while all the prior's parameters are taken from the data. Both simulation and real data experiments suggest that the use of BSP leads to a more accurate, precise and robust estimation of the DKI-FWE model parameters.

Towards Bayesian image reconstruction of quantitative MRI – Dirk Poot

A main problem in (quantitative) MR imaging is the required scanning time as well as subject motion. To reduce scanning time, acceleration techniques are used. These techniques amplify noise and/or require additional constraints in the reconstruction. New insights can be obtained by viewing that as prior information in a Bayesian framework. This talk will highlight several benefits that such formulation can provide as well as some practical obstacles.

Bayesian model-fitting to detect atomic columns from electron microscopy images – Jarmo Fatermans

Structure parameters from scanning transmission electron microscopy (STEM) are commonly estimated by using a physics-based model describing the image data. Hereby, the number of atomic columns in the image needs to be specified beforehand. In case the image has low signal-to-noise ratio (SNR), a visual inspection to determine the number of columns is unreliable and may lead to biased structure information. Therefore, a Bayesian model-fitting approach is proposed to detect atomic columns from STEM images in an objective way.

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Vrije Universiteit Brussel	Department of Nuclear Medicine
	Stochastics
Universiteit Gent	Image Processing and Interpretation
Universiteit Hasselt	I-Biostat
Katholieke Universiteit Leuven	Medical Imaging Research Center
	Institute of Astronomy
	Mechatronics, Biostatistics and Sensors (MeBioS)
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