“Living the DREAM” Seminar (University of Helsinki)

Organizer: Gregor Hillers, gregor.hillers@helsinki.fi

20 May 2026, at 09:00 – 15:30, Kumpula Campus, Exactum, B121

https://helsinki.zoom.us/j/65096355310?pwd=JLJ1tJKKH6PxWvBaEtdOPVapZUVQmk.1

08:30 – 09:00 Breakfast

Session 1

09:00 Welcome!!

09:05 **Inverse Obstacle Problems**, Ziyao Zhao, Department of Mathematics and Statistics, University of Helsinki

09:20 **Wave Speed Recovery from Spectral Data in a (1+1)-Dimensional Wave Equation**, Antti Hannukainen[1], Petr Kulikov[2], Matti Lassas[2], Lauri Oksanen[2]. [1]Department of Mathematics and Systems Analysis, Aalto University, [2]Department of Mathematics and Statistics, University of Helsinki

09:35 **Calderón’s forward problem with singularities using darned processes**, Eetu Halme, Petteri Piiroinen. Department of Mathematics and Statistics, University of Helsinki

09:50 **Dual-Grid Parameter Selection for Tomographic Inverse Problems**, Chuyang Wu

Coffee break

Session 2

10:30 **Improving reconstruction quality of Passive Gamma Emission Tomography**, Huaiyu Li, Peter Dendooven. Helsinki Institute of Physics, University of Helsinki

10:45 **Artificial Intelligence Gamma Ray Imaging Detectors**, Adeiza Anumah[1], Peter Dendooven[1], Andreas Hauptmann[2]. [1]Helsinki Institute of Physics, University of Helsinki, [2]University of Oulu

11:00 **Detecting Emissions from Space - A New Unsupervised Method for Finding Emission Hotspots from Satellite Data**, Elias Ervelä[1,2], Laia Amorós[2], Amanita Mikkonen[2], Johanna Tamminen[2]. [1]Department of Mathematics and Statistics, University of Helsinki, [2]Finnish Meteorological Institute

11:15 **Methodological Advances in Satellite-Based Point-Source Greenhouse Gas Emission Estimation**, Anssi Koskinen. University of Helsinki, and Finnish Meteorological Institute

Lunch

Session 3

13:00 **Rayleigh wave focal spot imaging of the Kylylahti mine area**, Valtteri Hopiavuori[1], Christina Tsarsitalidou[1], Kauri Kolehmainen[1], Gregor Hillers[1], Bruno Giammarinaro[2], Pierre Boué[3], Laurent Stehly[3], Yang Lyu[1], Michal Malinowski[4], Suvi Heinonen[1], Kari Komminaho[1]. [1]Institute of Seismology, Department of Geosciences and Geography, University of Helsinki, [2]LabTAU, INSERM, Université Claude Bernard Lyon 1, [3]Institut des Sciences de la Terre, Université Grenoble Alpes, [4]Geological Survey of Finland

13:15 **Deblurring seismic focal spot images**, Kauri Kolehmainen[1], Gregor Hillers[1], Hjørdis Schlüter[2], Bruno Giammarinaro[3], Markus Juvonen[2], Alexander Meaney[2], Samuli Siltanen[2]. [1]Institute of Seismology, University of Helsinki, [2]Department of Mathematics and Statistics, University of Helsinki, [3]LabTAU Inserm, University Claude Bernard Lyon 1

13:30 **Perception–based inversion methods**, Emilia Blåsten[1], Lílian Ferreira de Freitas, Jukka Häkkinen[2], Markus Juvonen[3], Saara Malila[3], Samuli Siltanen[3]. [1]Department of computational engineering, Lappeenranta University of Technology, [2]Department of psychology, University of Helsinki, [3]Department of Mathematics and Statistics, University of Helsinki

13:45 **Reconstructing the metric from relative distance comparisons Mattis Lassas**, Meri Laurikainen, Pekka Pankka. Department of Mathematics and Satistics, University of Helsinki

Coffee break

Session 4

14:30 **Expanding our understanding of street-level greenness: evaluation of mapping perceived greenery**, Jussi Torkko[1], Tuuli Toivonen[1,2,3], Elias Willberg[1,2,3]. [1]Digital Geography Lab, University of Helsinki, [2]Helsinki Institute of Sustainability Science (HELSUS), University of Helsinki, [3]Institute of Urban and Regional Studies, University of Helsinki

14:45 **Geo-computational modeling for understanding urban cycling behavior**, Xiao Cai. Digital Geography lab, University of Helsinki, and Helsinki Institute of Urban and Regional Studies (Urbaria), University of Helsinki

15:00 **Complementing respiratory infection hospitalization data through Bayesian modelling**, Joel Siurua[1,2], Simopekka Vänskä[2]. [1]Department of Mathematics and Statistics, University of Helsinki, [2]Finnish Institute for Health and Welfare (THL)

15:15 Open discussion and closing words

Inverse Obstacle Problems

Ziyao Zhao[1]

[1] Department of Mathematics and Statistics, University of Helsinki, Helsinki, Finland

Abstract

In this talk, we will give an introduction to some inverse obstacle problems and present the results that have been obtained. In particular, we study an inverse problem of determining an obstacle with Signorini contact boundary condition from boundary measurements for the isotropic elasticity system. We prove that the obstacle can be uniquely determined by a single measurement of displacement and normal stress for the Signorini problem on an open subset of the boundary up to a natural obstruction. In addition to considering the Signorini problem, we develop techniques that can be used to study inverse problems for general differential inequalities and obstacle problems.

Wave Speed Recovery from Spectral Data in a (1+1)-Dimensional Wave Equation

Antti Hannukainen[1], Petr Kulikov[2], Matti Lassas[3], Lauri Oksanen[4]

[1] Department of Mathematics and Systems Analysis, Aalto University, Espoo, Finland [2,3,4] Department of Mathematics and Statistics, University of Helsinki, Helsinki, Finland

Abstract

An inverse boundary spectral problem for a (1+1)-dimensional wave equation with wave speed $c(x)$ is considered. We propose a two-step recovery procedure. In the first step, the Neumann-to-Dirichlet map Λ is reconstructed from spectral data of the impedance spectral problem—a Sturm–Liouville eigenvalue problem for the spatial operator $-c^2(x)\partial_x^2$ on $[0,1]$. Namely, we show that the result of Kurylev, Lassas, and Weder (2005) on the generic behaviour of eigenvalues under Robin impedance perturbations yields a spectral representation of Λ. In the second step, the reconstructed map Λ is used within the regularization strategy for the boundary control method presented by Korpela, Lassas, and Oksanen (2016). The strategy recovers $c(x)$ by solving a sequence of optimal control problems driven by the Blagoveščenskiĭ identities.

As an improvement, the regularization of the control problems employs a weighted combination of L^2 and H^1 penalty terms. Furthermore, we prove a uniform convergence result for the sequence of optimal controls, thereby allowing the regularization parameters to be tuned simultaneously.

The method is implemented numerically and validated on both smooth and piecewise smooth wave speed profiles. The impedance spectral problem is discretized using the finite element method, yielding a forward simulation of Λ. Subsequently, the travel time volumes obtained via the regularization strategy are differentiated in order to compute the wave speed function. To reduce sensitivity to noise in the differentiation step, total variation and H^1 regularization are employed.

Numerical experiments demonstrate that the recovery of the wave speed exhibits high accuracy and robustness.

Calderón's forward problem with singularities using darned processes

Eetu Halme[1], Petteri Piiroinen[2]

[1] Department of Mathematics and Statistics, University of Helsinki
[2] Department of Mathematics and Statistics, University of Helsinki

Abstract

Calderón's inverse problem is the mathematical model for electrical impedance tomography (EIT), where the forward problem is given by the conductivity equation on a domain with Neumann boundary values. The conductivity equation is well-understood when the conductivity parameter is assumed to be uniformly elliptic and bounded. In this case, the solutions of the conductivity equation can be represented probabilistically by a Feynman-Kac formula for corresponding diffusion processes using the theory of Dirichlet forms.

We investigate a forward conductivity problem with singular inclusions in the domain, where the conductivity parameter is allowed to be unbounded. We connect the problem to a probabilistic interpretation using Markov processes with darning formulated in the language of Dirichlet forms. This is joint ongoing work with Petteri Piiroinen in the Department of Mathematics and Statistics in University of Helsinki.

Dual-Grid Parameter Selection for Tomographic Inverse Problems

Chuyang Wu

April 1, 2026

Abstract

We study ill-posed inverse problems in imaging and tomography, where stable reconstruction requires balancing data fidelity with prior regularization. In variational formulations, this balance is governed by a regularization parameter $\alpha > 0$, whose optimal choice remains an open challenge. We introduce a dual-grid parameter selection method that determines α by enforcing consistency between reconstructions computed from two slightly perturbed forward models. The method selects the smallest α for which the structural similarity $\mathrm{SSIM}(f_\alpha, g_\alpha)$ stabilizes, yielding a fully data-driven criterion that does not require noise estimates or ground truth. Experiments in image deblurring demonstrate that the approach works across different regularizers, including Tikhonov and total variation, and performs robustly on both simulated and real data. The results highlight regularization as a mechanism for stabilizing inference under uncertainty.

Improving reconstruction quality of Passive Gamma Emission Tomography

Huaiyu Li[1], Peter Dendooven[1]

[1] Helsinki Institute of Physics, University of Helsinki, Helsinki, Finland

Abstract

Passive Gamma Emission Tomography (PGET) is an imaging method for gamma radiation sources. In the current implementation of PGET for spent nuclear fuel assemblies, the method of image reconstruction features a regularized reconstruction with optimization methods, incorporating knowledge about the fuel assembly's geometry and physical constraints of radiation activity and attenuation. To extend the method to a wider range of spent fuel assemblies and to reduce measurement time, improvements on quality of reconstructed images are required. The research includes several different methods to improve the image's quality and the usefulness in fuel rod classification. On the preprocessing side, improvements can be made via incorporating simulated detector sensitivity corrections. Further for the regularization, a Joint Total Variation approach used to combine gamma emission from Cs-137 and from Eu-154, benefiting from characteristics of both gamma ray energies, is tested for a further improvement in images reconstructed from VVER-440 fuel.

Artificial Intelligence Gamma Ray Imaging Detectors

Adeiza Anumah, Peter Dendooven
Helsinki Institute of Physics
University of Helsinki, Finland
adeiza.anumah@hlesinki.fi , peter.dendooven@helsinki.fi

Andreas Hauptmann
University of Oulu, Finland
Andreas.Hauptmann@oulu.fi

Abstract

This study presents the development of an experimental and computational framework for gamma-ray imaging using semiconductor detectors enhanced by artificial intelligence techniques. The growing demand for high-performance radiation detectors in nuclear security, medical imaging, and astrophysics has driven the adoption of semiconductor-based systems, particularly Cadmium Zinc Telluride (CZT), due to its high atomic number, wide bandgap, and ability to operate at room temperature with excellent energy resolution. Compared to conventional detectors such as high-purity germanium (HPGe), CZT offers improved portability and efficiency, making it well-suited for modern gamma-ray detection applications.

To generate training and evaluation data, a narrow gamma-ray beam was systematically scanned across the surface of a GDS-100 CZT detector with position-sensitive readout. The beam was produced using a collimation system consisting of a 1 mm diameter, 50 mm long aperture drilled into a $10 \times 10 \times 5$ cm^3 lead block, resulting in a geometric efficiency of approximately 2.5×10^{-5}. Due to this low efficiency, radioactive sources with activities of several MBq were required to achieve sufficient counting statistics. A full-area grid scan over a 30 mm × 30 mm region with 0.5 mm step size was performed using a Cs-137 source with activity 3.91 MBq, yielding a total of 3721 measurement files.

The acquired dataset was used to train a convolutional neural network based on a compact residual network (ResNet) architecture with an upsampling component. The model learns to reconstruct higher-resolution spatial information from low-resolution detector data, mapping an 11 × 11 input representation to a 22 × 22 output. To further enhance spatial resolution, a multi-stage upscaling approach was employed ($11 \times 11 \rightarrow 22 \times 22 \rightarrow 66 \times 66$).

The integration of machine learning techniques with CZT detector data enables improved spatial reconstruction and has the potential to enhance gamma-ray imaging beyond traditional methods. This approach demonstrates how data-driven models can complement advances in detector physics, offering a pathway toward more accurate, efficient, and scalable radiation imaging systems.

Detecting Emissions from Space - A New Unsupervised Method for Finding Emission Hotspots from Satellite Data

Elias Ervelä[1,2], Laia Amorós[2], Amanita Mikkonen[2], Johanna Tamminen[2]

[1] Department of Mathematics and Statistics, University of Helsinki, Helsinki, Finland [2] Finnish Meteorological Institute, Helsinki, Finland

Abstract

A crucial part of tackling the problem of climate change is the monitoring of human-caused greenhouse gas emissions. To reach a global scale, greenhouse gas measuring satellites appear to be the best solution. Emissions from point sources, such as power plants, can produce distinct plumes that are visible from satellite data. Automated plume detection is key to identify and monitor the largest sources of human-caused greenhouse gas emissions.

We present a new unsupervised clustering-based algorithm, SCEA (**S**patial **C**lustering of **E**levated-valued **A**reas), for detecting and outlining hotspots in spatial datasets with continuous attributes. The method extends the principles of density-based clustering by introducing a value-dependent radius function that adapts locally to the density of the data and the magnitude of the attributes. Unlike many conventional hotspot detection approaches, SCEA does not require the data to be on a regular grid or to have well-defined neighbors, and it remains robust in the presence of missing values, all of which are common characteristics of satellite remote sensing data.

We evaluate SCEA's performance with various synthetic datasets, exploring the two main parameters of the algorithm and their relationship to different noise levels. Furthermore, we demonstrate its potential to capture meaningful information with Sentinel-5P TROPOMI satellite observations of tropospheric NO_2. The generality of the algorithm and its lack of dependence on training data make SCEA a promising tool for automatic hotspot detection in large-scale remote sensing and other spatial datasets with continuous attributes.

Methodological Advances in Satellite-Based Point-Source Greenhouse Gas Emission Estimation

Anssi Koskinen[1,2]

[1] University of Helsinki, Helsinki, Finland [2] Finnish Meteorological Institute, Helsinki, Finland

Abstract

With ongoing climate change and rising global temperatures, quantifying anthropogenic greenhouse gas (GHG) emissions has become increasingly important. Recent satellite missions, such as TROPOMI, along with the forthcoming CO2M constellation, provide high-resolution observations capable of capturing atmospheric signatures of emissions from individual point sources, including large power plants and industrial facilities, while offering global coverage.

Converting these observations into quantitative emission estimates is a complex inverse problem. Typical processing steps include automated plume detection, estimation of the atmospheric background, characterization of wind speed and direction, and inversion of column-average GHG enhancements into source-specific emission rates. Each step introduces uncertainties that must be carefully managed to ensure reliable results.

In this talk, we present two methodological developments relevant to this retrieval chain: a scattering graph method for 3D radiative transfer by Mikkonen, A. et al. [1], and a Gaussian process (GP) approach to the divergence method for emission quantification and uncertainty estimation by Anssi Koskinen, Janne Nurmela, Teemu Härkönen, & Johanna Tamminen.

References

[1] Amanita Mikkonen, Anssi Koskinen, Johanna Tamminen, and Hannakaisa Lindqvist. Scattering graph method for 3d radiative transfer. *Opt. Express*, 33(17):35489–35509, Aug 2025.

Rayleigh wave focal spot imaging of the Kylylahti mine area

Valtteri Hopiavuori[1], Christina Tsarsitalidou[1], Kauri Kolehmainen[1], Gregor Hillers[1], Bruno Giammarinaro[2], Pierre Boué[3], Laurent Stehly[3], Yang Lyu[1], Michal Malinowski[4], Suvi Heinonen[1], Kari Komminaho[1]

[1] Institute of Seismology, Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland [2] LabTAU, INSERM, Centre Léon Bérard, Université Claude Bernard Lyon 1, Lyon, France [3] Institut des Sciences de la Terre, Université Grenoble Alpes, Grenoble, France [4] Geological Survey of Finland, Geological Survey of Finland, Espoo, Finland

Abstract

The importance of non-destructive imaging methods in mineral exploration has grown in recent years as the demand for critical raw materials has increased. Methods that utilize seismic ambient noise to estimate the Green's function of the medium offer an efficient and economical approach for non-destructively imaging the subsurface, making them well suited for sustainable mineral exploration. Among these, the Rayleigh wave focal spot imaging method is particularly promising due to its potential depth resolution and inversion-free approach. It is based on the analysis of focal spots, a high-amplitude features formed from the spatial distribution of zero-lag amplitudes of Green's functions obtained by cross-correlating a reference station with all other stations in the seismic array. From their shapes, local Rayleigh wave velocities can be determined, serving as proxies for subsurface properties. We investigate, for the first time, the Rayleigh wave focal spot imaging method in near surface structural mapping in the context of mineral exploration. Our study area is the Kylylahti mining area in eastern Finland, which has an extensive research history and provides a valuable benchmark for validating our results. We compute Rayleigh wave velocity distributions from the focal spots across the array, creating velocity maps that characterize subsurface structures. From these velocity distributions, we perform a dispersion curve clustering analysis to characterize spatially coherent regions. Our results demonstrate that the focal spot method provides a robust imaging tool for shallow subsurface characterization, even under non-ideal wavefield conditions. From the velocity maps and dispersion curve clustering analysis, we identify a low-velocity zone corresponding to the Kylylahti formation, surrounded by higher-velocity areas. The existing geological model validates our findings, showing that the velocity distributions are consistent with the known geology of the study area.

Deblurring seismic focal spot images

Kauri Kolehmainen[1], Gregor Hillers[1], Hjørdis Schlüter[2], Bruno Giammarinaro[3], Markus Juvonen[2], Alexander Meaney[2], Samuli Siltanen[2]

[1] Institute of Seismology, University of Helsinki, Helsinki, Finland [2] Department of Mathematics and Statistics, University of Helsinki, Helsinki, Finland [3] LabTAU Inserm, University Claude Bernard Lyon 1, Lyon, France

Abstract

Conventional seismic tomography methods invert quantities such as wave traveltime measured between seismic instruments. The focal spot imaging technique provides an inversion-free method for imaging the subsurface using surface wave spatial autocorrelation fields computed from seismic ambient noise cross-correlations. Seismic wave velocities are estimated from focal spot data in the one-wavelength distance range through regression using a Bessel function model. Performing focal spot imaging on dense seismic arrays provides high-resolution images of seismic wave velocity estimates comparable to direct light intensity measurements in optical images. Focal spot images are inherently blurred because distant data are used to constrain local velocities in the regression step. In optical images, blurring is undone by deconvolving the blurred image with the corresponding point spread function that describes the blur caused by the imaging device. The direct focal spot imaging approach provides a unique opportunity to perform similar deblurring on seismic velocity images. We estimate the focal spot imaging point spread function by imaging a point-like high-velocity inclusion in two-dimensional acoustic simulations. We apply the estimated point spread functions to reconstruct improved focal spot images using deconvolution solved with Tikhonov and mollified total variation regularization. The image reconstructions show significant improvements compared to blurred focal spot images, as confirmed both visually and quantitatively.

Perception–based inversion methods

Emilia Blåsten[1], Lílian Ferreira de Freitas, Jukka Häkkinen[2],
Markus Juvonen[3], Saara Malila[3], Samuli Siltanen[3]

[1] Department of computational engineering, Lappeenranta University of Technology, Lappeenranta, Finland
[2] Department of psychology, University of Helsinki, Helsinki, Finland
[3] Department of mathematics and statistics, University of Helsinki, Helsinki, Finland

Abstract

Despite the important role of visual evaluation in the field of imaging, the relationship between perception and image contents or quality is generally disregarded in research. We propose a new avenue of research to develop methods of determining image quality in such a way that it is the best fit for the end user's needs. Such a project requires a combination of ideas and methods used in mathematical and psychological research. Despite the complexity of merging concepts from these two very different fields, this approach is necessary in understanding the effect of the human element in producing and analyzing visual data.

We begin the research into this complicated issue by studying a simpler situation from which we can then expand to a wider area. We select a noisy base image, and construct a parameter grid corresponding to total variation denoised solutions of different strengths. We perform psychometric scaling on these parameters, resulting in a set of images that displays all the different levels of quality (noisiness) detectable to the human eye, but that does not contain any redundant data. Simultaneously, the set is optimized for further use in the second part of the research campaign.

In the second part, we conduct a comparison test on the previously constructed set to find out which denoising parameter(s) result in the best perceived image quality. A Metropolis-Hastings algorithm is used to create a model of the pairwise data obtained from the test.

Reconstructing the metric from relative distance comparisons

Mattis Lassas[1], Meri Laurikainen[1], Pekka Pankka[1]

[1] Department of Mathematics and Satistics, University of Helsinki, Finland

Abstract

Humans have a hard time estimating the similarity of pictures in terms of raw numbers, but they can fairly consitently pick out the two most similar pictures out of a set of three. What can we infer from data consisting of such relative comparisons?

In this talk, I will present an overview of a theoretical method for constructing a metric that is consistent with the given relative comparison data.

Expanding our understanding of street-level greenness: evaluation of mapping perceived greenery.

Jussi Torkko[1]
Tuuli Toivonen[1,2,3], Elias Willberg[1,2,3]

[1] Digital Geography Lab, Department of Geography and Geosciences, University of Helsinki
[2] Helsinki Institute of Sustainability Science (HELSUS), University of Helsinki
[3]Institute of Urban and Regional Studies, University of Helsinki

Abstract

The presence of greenery, the natural green vegetation, is of great importance to our wellbeing, providing various physical, psychological and social benefits. While it has been traditionally observed with a top-down approach, through the lenses of aerial vehicles, there is an increased interest in mapping the greenery that people perceive on the street level. By incorporating novel visual indices into planning procedures and metrics, cities and stakeholders are also keen to understand how people experience their daily commutes and activities. The recent approaches commonly use computer vision and massive street view imagery datasets to quantify what is visible on street level, but also more experimental techniques such as point cloud analysis, viewshed mapping and AI are being tested. However, most of the current methods still simplify the whole experience of perceiving greenery into limited and largely unexplored indices, where the broader dimensions and dynamism of greenery are forgotten or blatantly ignored.

My work challenges the surprisingly stagnant state of the methodology behind our street-level greenery calculations. I empirically show how methodological choices made on the various mapping methods can have a wide range of impacts on the results gained. I also try to understand how the dynamic, preferential, and temporal nature of greenery should be quantified, to show that the perception of greenery is more complex and nuanced than a single number might indicate. To do this, I use a mix of computer vision techniques, big data, surveys, AI, virtual reality, modelling and rigid empirical testing. With my results, I hope to improve our current methodologies on street-level greenery, so that its benefits can better be brought to people's daily lives.

Geo-computational modeling for understanding urban cycling behavior

Xiao Cai[1,2]

[1] Digital Geography lab, Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland [2] Helsinki Institute of Urban and Regional Studies (Urbaria), University of Helsinki, Helsinki, Finland

Abstract

This doctoral dissertation aims to understand the dynamics (i.e., demographic, spatial, and temporal disparities) of urban cycling behavior using both empirical and simulation-based approaches. Specifically, it investigates the mechanism underlying cycling demands and route choices and, therefore, generates synthetic data of cycling flows in the city. At the demographic level, it explores the differences in cycling behavior between gender groups (i.e., men and women) and among age groups (i.e., children, teenagers, young adults, middle-aged adults, and seniors). At the spatial level, it analyzes where people cycle and how their perceptions of built environments along the route vary across various European cities (i.e., Copenhagen, London, Helsinki, Munich, and Las Palmas). At the temporal level, it evaluates how cycling behavior differs on a hourly, daily, and seasonal basis. The findings of this doctoral dissertation can provide relevant stakeholders (e.g., planners and policy makers) with significant implications to establish a more sustainable, inclusive, and equitable urban environment.

Complementing respiratory infection hospitalization data through Bayesian modelling

Joel Siurua[1,2], Simopekka Vänskä[2]

[1] Department of Mathematics and Statistics, University of Helsinki
[2] Finnish Institute for Health and Welfare (THL)

Abstract

Respiratory infections (such as influenza, COVID-19 and RSV) cause a significant burden on the healthcare system every year. Around 30 000 people are hospitalized in Finland yearly due to respiratory infections. Information about the numbers and causes of hospitalizations is stored in a register maintained by the Finnish Institute for Health and Welfare.

Since respiratory infections are symptomatically very similar, it is usually impossible to diagnose the infectious agent without microbiological testing. Thus, a notable portion of the hospitalization data lacks specific diagnoses. Accurate diagnosis information would be important for planning interventions such as vaccinations as well as monitoring their effectiveness.

To address this problem of underreporting, we develop a method to classify the undiagnosed hospitalization data between known pathogens of interest and background infections. The proposed method uses Bayesian inference and Markov chain Monte Carlo sampling to estimate the unobserved numbers of hospitalizations caused by the target pathogens. The performance of the method is assessed by applying it to a variety of simulated data sets.