Titles and abstracts

Smögen workshop 2008

Aila Särkkä: Space-time growth-interaction processes with moving objects versus the force biased algorithm

Abstract: The so-called force biased algorithm has commonly been used to produce random (dense) packings of balls. The idea is to start with a random configuration of balls with a given size distribution uniformly distributed in a container. Overlaps are then gradually reduced by shifting the balls and adjusting their sizes until the desired volume fraction has been reached. The only stochasticity of the approach comes from the initial configuration. The algorithm is widely used and works well but it is not so easy to write down a mathematical decription of it. Also, it seems to produce very regular patterns with hardly any touching balls. We suggest using the immigration-growth spatial interaction processes (see the abstracts by Eric Renshaw and Ottmar Cronie) with moving balls to create random packings of balls. In this talk we will first discuss how moving of the balls affects some summary statistics of the produced marked point patterns. Then, similarities and differences between our approach and the force biased algorithm are discussed, and some very preliminary results on how the statistical properties of the pattern created by these two approaches differ from each other are shown.

Anastassia Baxevani: Gaussian spatial fields dynamically evolving in time

Abstract: We discuss a general method of defining non-stationary spatio-temporal surfaces that involve also dynamics governed by the velocity fields. The approach formalizes and expands previously used models in analysis of the satellite data on significant wave heights. We start with homogeneous spatial fields and by applying an extension of the standard moving average construction we arrive to stationary in time models. The obtained model can be consider as dynamically inactive as its velocities are centered at zero. We introduce a dynamical evolution to such a field by composing it with a dynamical flow governed by some velocity field. This new and, in general, non-stationary model extends the previous discretized moving averages model accounting for a velocity of traveling surface. Statistical fitting of such models is fairly straightforward and is illustrated by models of significant wave heights over large areas of the sea.

Arnoldo Frigessi: Weather events and damages to buildings: a Bayesian spatial variable selection model

Abstract: We have just started a four year European project on Climate Change and the Insurance Industry (CCII), as a Marie Curie Industry and Academia Partnerships and Pathways (IAPP) grant. The partners are the Lloyds in London, the Centre for Applied Time Series at the London School of Economics, the Oslo centre of excellent Statistics for Innovation $(\text{sfi})^2$ and the Norwegian Insurance company Gjensidige. The aim of the project is to bring statisticians,insurance and climate experts together to help build a methodological basis for the emerging field of climate change insurance risk. In this lecture I will report on the first steps we have been able to make so far. We have access to data on claims in Norway related to damages produced by adverse weather conditions, together with several observed weather variables. I will present a space-time regression model, where selected weather covariates modulating probabilities for claims in each municipality follow a Markov random field prior. I will also give some preliminary results on future trends under climate scenarios.

Claudia Lautensack: Anisotropy analysis of 3D point processes

Abstract: Methods for the anisotropy analysis of planar point processes have been introduced e.g. in [1] and [2]. The statistics defined there carry over to the three-dimensional case without any difficulties. However, working with 3D data makes the practical evaluation and the illustration of results more challenging than in the planar case.

We present methods for the analysis of anisotropies in three-dimensional point processes. The distribution of directions from a point to its nearest neighbour is investigated using methods from spherical statistics. Further, some approaches based on directional versions of the K-function and the nearest neighbour distance distribution function are discussed.

Using these methods we analyse some point patterns observed in polar ice. This ice consists of compacted snow: The ice in deeper layers is compressed by the weight of newly fallen snow. The gain due to snowfall is balanced by a flow sidewards keeping the total height of the ice sheet nearly constant. During this process, air pores are isolated within the ice. The question discussed in this work is whether the spatial arrangement of the pores can tell us something about the interaction of the compaction and the flow process. We investigate point patterns consisting of the centres of the air pores which are extracted from tomographic images of pieces of ice cores. Samples taken from different depths are considered.

[1] Stoyan, Kendall, Mecke (1995). Stochastic Geometry and its Applications, Wiley, Chichester [2] Stoyan, Benes (1991). Anisotropy analysis for particle systems. Journal of microscopy 164, 159-168.

Clive Anderson: Uncertainty in Environmental Models

Abstract: Numerical models are being increasingly used in environmental sciences. They enable the scientist to encapsulate process knowledge, to explore interactions and to make predictions. Weather forecasts and predictions of climate change, for example, rely on them. In many cases the models are deterministic, often based on large sets of differential equations, and in most cases (in common with almost all models) they are wrong. That is not to say that they are useless. A major challenge in their use - vital for scientific advances and practical decision-making - is to say how far wrong they are likely to be - to quantify their uncertainty - and where they need improvement. Statistics, as the methodology of inductive inference under uncertainty, should have relevant things to say here. The talk will describe one way of trying to quantify the uncertainty of such models using Bayesian ideas, and will illustrate it in relation to estimation of the net uptake of carbon dioxide by a country's vegetation.

Eric Renshaw: Spatial-Temporal Marked Point Processes : A Spectrum of Stochastic Models

Abstract: The construction and analysis of spatial-temporal marked point processes has been fuelled by two separate fields of study. In biology, plants are often affected by others that compete with them for nutrient and natural resources. Whilst fundamental to the study of porous and granular material is the modelling and statistical analysis of random systems of hard particles. Renshaw and Särkkä (2001) (R&S) and Särkkä and Renshaw (2006) (S&R) construct a general high-intensity packing algorithm that covers both situations in order to infer properties and generating mechanisms of space-time stochastic processes. Marks $m_i(t)$ $(i = 1, \ldots, n)$ have location x_i and change size through the *deterministic* incremental size change

$$m_i(t + dt) = m_i(t) + f(m_i(t))dt + \sum_{j \neq i} h(m_i(t), m_j(t); \|x_i - x_j\|)dt \ . \quad (1)$$

Here $f(\cdot)$ denotes the mark growth function in the absence of spatial interaction, and $h(\cdot)$ is an appropriate spatial interaction function taken over all points $j \neq i$. Random variation can be induced in a variety of different ways, such as via the simple immigration-death process. Note that if $m_i(t + dt) \leq 0$ then point i dies 'interactively' and is deleted, as happens for natural death.

As the simple birth function $f(m_i(t)) = \lambda m_i(t)$ is unbounded, stable forms such as the linear and logistic processes $f(m_i(t)) = \lambda(1 - m_i(t))$ and $f(m_i(t)) = \lambda m_i(t)(1 - m_i(t)/K)$ may be preferred. These are special cases of the logistic power-law process $dm(t)/dt = am(t) - d[m(t)]^{p+1}$, which has the solution $m(t) = K[1 + ce^{-apt}]^{-1/p}$ for $K = (a/d)^{1/p}$ and $c = [K/m(0)]^p - 1$. This form has played a major role in forest modelling via the Von Bertalanffy-Chapman-Richards growth function

$$f(m_i(t)) = a_0 m_i(t)^{a_1} - a_2 m_i(t) \ . \quad (2)$$

Here $a_0 = \beta K^v/v$, $a_1 = (1 - v)$ and $a_2 = \beta/v$; where K is the tree-size carrying capacity, β scales the time axis, and v defines the curve shape. Two particular forms for $h(\cdot)$ cover a wide range of situations. The first is the symmetric hard-core interaction function

$$h_1(m_i(t), m_j(t); \|x_i - x_j\|) = -bI(\|x_i - x_j\| < r(m_i(t) + m_j(t)) \ , \quad (3)$$

where $I(F) = 1$ if F is true and $I(F) = 0$ otherwise. Whilst to construct an asymmetric soft-core form that takes account of the relative sizes of two interacting marks, let $D(x_i, r)$ denote the disk with centre x_i and radius r, and place

$$h_2(m_i(t), m_j(t); \|x_i - x_j\|) = \\ -b \ \text{area}\{D(x_i, rm_i(t)) \cap D(x_j, rm_j(t))\}/(\pi r^2 m_i^2(t)) \ . \quad (4)$$

R&S use maximum pseudo-likelihood to estimate parameters for patterns that are sampled at a *fixed* time point, whilst S&R develop a least squares procedure for *successive* time points. As examples of this approach will be presented in earlier talks, here we demonstrate how it may be used in a forestry application to compare two proposed thinning regimes.

Now whilst the admission of immigration (or birth) and death injects sufficient randomness into the system for the algorithm to work well in biological scenarios, in materials science neither of these random processes are likely

to present. This means that the technique is now wholly deterministic and so the stochastic nature of the process has to be viewed afresh. Six different possible approaches are therefore presented in decreasing order from fully stochastic to deterministic, and are illustrated by applying them to the simple immigration-death process. These are based on: (a) exact event-time pairs; (b) time-increments; (c) tau-leaping; (d) Langevin-leaping; (e) chemical reaction rates; and, (f) deterministic reaction rates. Remarkably little attention has been paid to the relationships which exist between these techniques, and this area of investigation holds many potentially exciting future challenges.

Extending these ideas to marked point processes requires two specific extensions. First, the growth and interaction functions, $f(\cdot)$ and $h(\cdot)$, have to be decomposed into general stochastic birth and death components. Second, as each marked point is affected differently we have to switch over into using an individual-based approach. The R&S procedure, which is essentially a combination of (f) and a stochastic immigration-death process, may be easily generalised to encompass the other approaches (a)-(e) across a wide range of disciplines, including particles moving under interaction pressure. If the exact algorithm (a) incurs too large a compute-time penalty, then the approximations (b)-(e) should be analysed in sequence in order to assess the trade-off between pattern structure and computational efficiency. This is of particular importance when developing models for large structures or systems under high-intensity packing which may take a long time to burn-in. Studies are currently being undertaken to generate models that accurately replicate three-dimensional packing structures for mixed-sized particle systems which previously could only be simulated by using 'sequential packing under gravity' and 'collective rearrangement strategies'. Whilst a further promising avenue would be to transfer methods recently developed for chemical reaction systems with a low to moderate number of molecules across to marked point processes. The scope for future development in this arena is enormous.

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Särkkä, A. & Renshaw, E. (2006) The analysis of marked point patterns evolving through space and time. *Computational Statistics and Data Analysis*, **51**, 1698-1718.

Igor Rychlik: Uncertainty in fatigue life prediction of structures subject to random loads.

Abstract: In the talk we shall present a simple measure of risk for fatigue of a component during a specific time period, the so called "safety index", The index will be used to combine different types of uncertainties. The presented methodology can be applied in a more general situation of environmental loads which properties may vary with time of the year. The load is assumed to be "locally" stationary such that the mean load is constant (and taken to be zero) but the variance of the load can change slowly with time. An example, taken from offshore applications, will be given.

Jacques de Maré: On loads in the load strength model

Abstract: In one formulation of the load strength model the equivalent strength is compared to the equivalent load. It is natural to think of an equivalent load as an average load but if the random load model is irregular the average load is close to zero. A remedy of this problem is presented based on the procedure at PSA (Peugeot-Citroën) and the work of Pär Johannesson and Igor Rychlik.

The total damage caused by the load, during the design life in question, is not divided by the almost infinite number of cycles but by some finite number i.e. one million. The corresponding equivalent load is compared to the endurance limit.

Jenny Jonasson: Likelihood estimation of diffusion coefficients from sequences of confocal microscope images

Abstract: Fluorescence recovery after photobleaching (FRAP) is a technique for studying diffusion of fluorescent molecules. The fluorochromes are bleached, deactivated, by a high intensity laser pulse in a limited volume of the sample, in our case a cylinder. After the bleaching adjacent unbleached fluorochromes diffuse into the bleached volume, resulting in a recovery of the fluorescence intensity. The recovery is studied by a sequence of confocal images in the x-y plane. The bleached region is assumed to be rotationally symmetric. From the first image a concentration profile is estimated using isotonic regression. The concentration at each time point is then calculated as a function of the diffusion coefficient using Fick's law. The noise in the images is described by a Poisson distribution and the diffusion coefficient is estimated by maximum likelihood. Compared to conventional modelling of the average intensity of the bleached region, our approach utilises the data more effectively and it is possible to extend it to inhomogeneous systems.

Jonas Ringsberg: Assessment of uncertanties in life prediction of fatique crack initiation in rails - influence of residual stresses from manufacturing

Abstract: The risk for initiation of fatigue cracks in the web in the weld zone of a rail is studied. The interaction between the welding residual stress field and the stress field caused by service loads is simulated in a nonlinear finite element (FE) analysis where the welding residual stress distribution (shape) and magnitude, the service load magnitude, and the material parameters used in the fatigue life estimation are varied. The initiation of fatigue cracks is assessed using the shear-stress-based multiaxial fatigue criterion proposed by Dang Van. In addition, the accuracy in the fatigue life assessment is evaluated by statistical uncertainty analysis where the variances according to the Gauss approximation formula are studied. It is seen that the welding residual stress enhances the risk for fatigue crack initiation in the rail web, and that the uncertainty in load level dominates the uncertainty in the fatigue assessment.

Jörg Wegener: Analysis of upper extremes in skewed records using a non-Gaussian second order model

Abstract: The spatial and often temporal dependence structures as expressed by correlation patterns in environmental data records are at the center of investigations in fields like ocean engineering or statistical weather data modelling. Because of elegant multivariate properties of Gaussian distributions and their natural and relatively simple ties to the correlation structure of the fields, they are overwhelmingly used in applications.

However, many actual records exhibit skewed distributions along with asymmetric upper and lower extremes. Nevertheless it is common practice to deterministically transform data to serve the Gaussian assumption. While the interest is typically in one sided (usually upper) extremes, these approaches treat both extremes in the same manner due to symmetry of the distributions.

We investigate whether intrinsically asymmetric second order models based on skewed Laplace distributions could improve inference about one sided extremes. The comparison is made both for the data simulated from an asymmetric model and for actual data of sea surface elevation and significant wave height. The relevance of accounting for intrinsic skewness is quantified through the dependence on the parameters controlling asymmetry and tails of the distribution. Crossing high level intensities and distributions are used in the comparison.

Keywords: Extremes, skewness, asymmetry, Laplacian model, level crossing, Rice formula, wave height

Krzysztof Podgorski: A class of non-Gaussian second order random fields
Abstract: Non-Gaussian stochastic fields are introduced by the means of integrals with respect to independently scattered stochastic measures that have generalized Laplace distributions. The leading model are continuous moving averages which, as opposed to its Gaussian counterpart, have a possibility of accounting for asymmetry and heavier tails. Aside of this greater flexibility, the discussed model still share a lot of spectral properties with Gaussian processes. It extends directly to random fields and thus can be suitable for modeling environmental data that are used in engineering sciences. For example, distributions of spatio-temporal characteristics can be obtained by the means of generalized Rice's formula. Fitting the model to the data in hand is fairly straightforward. It is made in two steps: first covariance structure is estimated and by its means the kernel used for moving averages is obtained, then, in the next step, parameters of the underlying Laplace motion are estimated based on the method of moments to fit kurtosis and skeweness. Work is joint with Sofia Åberg.

Mao Wengang: Estimation of vessel's fatigue accumulation along its voyages

Abstract: As the use of higher strength materials, severe environmental conditions and optimized structural dimensions, people have to pay much more attention on how those factors influence ships' fatigue damage. Especially, nowadays fatigue cracks can be found on the ship structure much earlier than expected, which makes a great threat to ships' safety. Considering that most of the fatigue accumulation is caused during its shipping period on the ocean, we developed a simple model in this presentation in terms of significant wave height, through analysis of the encountered sea states and its response parameters for the shipping passages. Finally, the fatigue damage for one voyage is calculated from its measured stress signal by rain-flow method as criterion to check model's validity, and for this case the model estimation agrees well with the "right" damage.

Mats Rudemo: Estimation of diffusion coefficients: from Brown, Einstein and Perrin to present-day statistical methods

Abstract: Brownian motion and diffusion has a long history starting with Brown's study 1828. With Einstein's paper 1905 started a period of intense research on diffusion with fundamental papers by Smoluchowski, Langevin and Perrin. Wiener's paper from 1923 is a landmark from a mathematical point of view. Present-day methods for estimation of diffusion coefficients include microscopy, FRAP and NMR. In this talk the history of diffusion will be briefly reviewed from a mathematical and statistical point of view. Special emphasis will also be placed on the use of statistical methods for design and analysis of experiments.

Ottmar Cronie: Estimation and edge correction in the Renshaw-Särkkä model

Abstract: First, in 2001 and later in 2006 Renshaw and Särkkä presented a certain spatio-temporal marked point process. The model is governed by an immigration-death process, describing the arrivals and deaths of the individuals (whose positions are uniformly distributed on the region of interest), together with a deterministic growth equation, controlling the individuals' mark sizes. The growth expression consists of two parts, one which controls the individual growth and one which controls the interaction with other surrounding individuals. The estimation procedure was carried out by employing least squares methods, which were shown to give satisfactory estimates for some of the parameters but biased estimates for others. In this talk the model and different variations of it are presented. Also considered are different aspects of the estimation procedure, including possible parameter bounds and changes in the estimation procedure when the model is altered. The last part of the talk will be about the different edge effect correction methods constructed and possible further developments.

Pär Johannesson: A Load-strength Model for Fatigue Applications

Abstract: For components in service, fatigue is an extremely complex phenomenon. Material properties, non-metallic inclusions, surface finish, scratches, geometric anomalies and other defects are all highly influential on the fatigue strength. Since many of these influential variables are not measurable beforehand, any fatigue life prediction is very uncertain. The service loads acting on the component are also very uncertain. They vary with time for each single user, but more importantly they differ between different users, missions, and environments. Uncertainties for both strength and load can be taken into account either by using overall safety factors based on engineering judgement or by using probabilistic methods, modelling the influential variables as random variables. The overall safety factor approach has the weakness that it is difficult to update, whereas the statistical methods have the weakness that the knowledge about the involved random variables is vague, especially in the tails of the distributions. Here, we therefore propose a compromise between probabilistic design and a deterministic safety factor approach. We use a second order statistical method to determine the prediction uncertainties, but include an extra safety factor covering uncertainties we have not been able to take care of by the probabilistic model, e.g. because of uncertain distribution tails. Second order statistics is used, since it complies with the information usually available about influential variables. It only uses mean values and variances of the input variables, combines them into means and variances of the logarithm of the strength and the load, respectively, and finally compares these two resulting random properties for a reliability assessment. The uncertainties in load and strength can come from variation in material properties, tolerances, customer usage, and so on. However, also statistical uncertainties and model uncertainties are easy to incorporate, e.g. uncertainties in parameter estimation, and model errors in fatigue models or FEM calculations. For the load-strength model we need a simple and robust model for the fatigue life. Here we propose the Basquin equation, together with the Palmgren-Miner damage accumulation rule. The strength variable is defined as the endurance limit at fixed number of cycles, N_0, say, e.g. one million cycles. The load variable is defined as an equivalent load amplitude, which is defined as the amplitude of a constant amplitude load with N_0 cycles, which gives the same damage as the measured load scaled to the target life. The reliability assessment is based on the comparison of the load and strength variables. The result can be expressed in terms of a central safety factor for the medians of the strength and load, namely a multiplication of a deterministic and a statistical safety factor

$$\phi = \frac{S_{0.50}}{L_{0.50}} = \phi_d \cdot \phi_s$$

where $\phi_s = e^{\beta\tau}$ with β being the reliability index and τ the prediction uncertainty. The proposed method will be demonstrated for an automotive application. The strength of the component is determined from variable amplitude fatigue tests, and the load is found from measurements in service.

Pierre Ailliot: Space time modeling of precipitation using hidden Markov models

Abstract: In this talk, I will introduce a space-time model for daily precipitation over mesoscale spatial areas. Such models have important applications. For example, they can be used as stochastic rainfall generators to provide realistic inputs to flooding, runoff and crop growth models, and also as components within general circulation models. A variety of stochastic models have been proposed in the literature, and among them the weather type models play an important role. The basic idea of these models consists of introducing an extra variable to describe the meteorological regime (weather type), and assume that this variable explains most of the space-time structure of the data.

In the model proposed in this talk, the weather type is introduced as a hidden Markov chain, and precipitation within weather types are described using censored power-transformed Gaussian distributions. The latter provide flexible and interpretable multivariate models for the mixed discrete-continuous variables that describe both precipitation, when it occurs, and no precipitation. Finally, the proposed model is a hidden Markov model, in which the hidden process has a discrete component (the weather type) and a continuous component (due to the censoring).

The parameters will be estimated using a Monte-Carlo EM algorithm and the fitted model will then be validated on rainfall data from a small network of stations in New Zealand encompassing a diverse range of orographic effects. We will show that it provides a better description of the spatial structure of precipitation than a more conventional HMM commonly used in the literature.

Salme Kärkkäinen: Orientational analysis of fibrous structures

Abstract: The orientational structure of carbon nanotubes in conductive polycarbonate is analysed. The data is in the form of greyscale images. Carbon nanotubes are considered as a fibre system. As a model for carbon nanotubes, we propose a Boolean model of deformed line segments based on the multivariate von Mises distribution. The estimation of parameters of that distribution is performed by the maximum likelihood method. The parameters are compared with respect to some production parameters of nanotubes. Some simulation examples are also shown.

Sara Lorén: Fatigue Limit and Inclusions
Abstract: Many fatigue properties of materials are governed by the defect contents in the material, either at the surface, or in the interior. Especially for hard steels the fatigue limit is coupled to the size distribution and the intensity of non-metallic inclusions. The idea of the weakest link model gives the conclusion that the most detrimental defect will decide the actual fatigue limit for a component or specimen. However, the most detrimental defect is not necessarily the largest one since a large defect may be exposed to a small local stress and a small defect to a large local stress. The distribution of the maximum inclusion size in a material may be estimated in three different ways, namely

1. by Extreme Value Analysis (EVA), where the maximum inclusion size in different control areas are measured,
2. by fatigue tests, where the detrimental inclusion is experimentally found, and
3. by ultrasonic testing, where inclusions in a scanned volume may be observed, and their sizes measured.

The final application of interest is the maximum inclusion size in a large volume representing the stressed volume in a component. This volume may be a thousand times or larger than the tested volume in the EVA case. For fatigue tests the stressed volume of the specimen may be in the same order as for a component. Here point 2 above will be treated. The relation between defect content and the fatigue limit for components with non-homogeneous stress. Methods for estimating the defect size distribution from fatigue tests with non-homogeneous stress states, e.g. rotating bending tests, and uniaxial test procedure of notched specimens.

Sofia Åberg: The Laplace driven moving average - a non-Gaussian stationary process (joint work with Krys Podgorski and Igor Rychlik)

Abstract: Stationary Gaussian processes and fields have successfully been used as a model in environmental and engineering applications for a long time. The popularity of this class of models is mainly due to its simplicity - the full model is specified once the covariance function or, equivalently, the spectral density function is given. However, these models have a drawback when it comes to describing the marginal distribution of the data since the Gaussian distribution is both light-tailed and symmetric. In this talk an alternative model - the Laplace driven moving average - is discussed. This model still possesses a spectral density at the same time as it allows for a larger flexibility when it comes to describing the marginal distribution. For example it is possible to have a skewed marginal distribution and tails that are heavier than the Gaussian ones. The model is defined as a continuous time moving average where the innovations have a generalized Laplace distribution. Several topics related to this model will be discussed such as frequency domain simulation and a Monte-Carlo approach to evaluate Rice's formula for the intensity of level crossings.

Sofia Tapani: Modeling and testing non-uniformness of the mouse embryo

Abstract: The problem setting comes from the Magdalena Zernicka-Goetz group at the Gurdon Institute in Cambridge. The institute supports research in the complementary areas of cancer research and developmental biology. The Magdalena Zernicka-Goetz group studies the development of the mouse embryo which is a good model for the human embryo. It is different from most non-mammalian species in the sense that the development does not follow a fixed set of instructions. Cell fate is flexible meaning that the development can recover from perturbations. However the early mouse egg is not merely a uniform ball. The cells show some preferences for adopting certain positions that will in turn govern what they develop into. The group's main questions are: How is the polarity of the egg first established? How are the decisions made to allow early embryonic cells to shift their division patterns from being initially symmetric to asymmetric? Their aim is to understand how this early patterning influences the development of first signaling centers that establish the anterior-posterior axis of the mouse embryo.

What we try to do is to introduce new ways of modeling and testing this possible early non-uniformness in the mouse embryo. We start from the beginning of fertilization with modeling the pronuclei migration which leads to the first diploid cell. After this the mitotic divisions start and the egg develops into an embryo. Further down the way the embryo develops into the blastocyst with evident anterior-posterior axis. Is there a pattern in the cell positions in the blastocyst which can be deduced from the very early development? Can we relate this axis to the two cell stage or even earlier to the pronuclei migration and sperm entry? Do cells with a certain fate come from the same areas in the 8 or 16 cell stage? I will present our main questions and ideas on this problem setting.

Thomas Galtier: Assessment of extreme responses distribution for a Non-Linear Hydro-Mechanical system

Abstract: In this study we discuss different methods to estimate extreme responses distribution of a non-linear hydro-mechanical system. Those methods are based on the evaluation of the level crossing rate which is easily related to extreme values statistics for a stationary random processes and large levels. In our case we consider a second-order wave loadings with Gaussian noise in input. But a little discussion take attention on a different input call Laplace driven Moving Average who seems followed in a better way the behavior of the waves. We applied all these methods (based on Rice formula or 'black box' methods) to the surge motion of a floating body subjected to unidirectional waves.

Thomas Svensson: Modeling unknown errors as random variables

Abstract: In simple linear regression the statistical model is written,

$$y = ax + b + \varepsilon,$$

and in realisations the term denoted ε is modelled as a number of IID random variables. In most applications this assumption is doubtful; the linear model is an approximation and the ε-term includes model errors and is consequently x-dependent. How does this fact influence the statistical analysis of data sets, the estimates of the parameters and the prediction uncertainty?

In stepwise regression, rejected influential variables are included in the error term ε. Future reference sets for obtaining the model may need to guarantee a random representation of the neglected variable values.

In measurement uncertainty one distinguish between systematic and random sources of uncertainty, but the values of the systematic errors are unknown. What are the differences between a random source and an unknown systematic source? What implications can be expected by modelling the systematic sources as random variables?

In reliability studies of mechanical structures the uncertainty in the strength assessment depends highly on potential errors in the physical models. Can these errors be interpreted as random variables and be combined with variational sources by statistical methods in order to find proper safety margins?

In order to make practical use of the powerful statistical tools, I believe that it is necessary to find ways to interpret unknown systematic errors as random variables. A proper interpretation is a way to take the right precautions and find the limits of usage of the statistical models.

Tommy Norberg: Added value in fault tree analyses

Abstract: It is recognized that the usual output of a fault tree analysis in some studies is not sufficiently informative. For added value in a widely used instrument for doing risk and reliability analyses, a Markovian approach is suggested. It is shown how to extend the calculations of the standard fault tree gates, so that information is available not only on the failure probability at the top level, but also on estimates of the failure rate and mean down time. In applying this to an integrated fault tree analysis of a municipal drinking water system, we further identified the need for logic gates that are variations of those currently in use.

Torbjörn Lundh: Cross-ratio invariances of human limbs?

Abstract: The cross-ratio is an ancient tool that surprisingly has a very natural meaning in complex analysis. It has been suggested by Pethukov 1989 that there is an invariance of human limbs with respect to the cross-ratio in the following sense: if a is the distance from your shoulder to your elbove, b the distance from the elbove to the wrist, and c the length of your hand (wrist to tip of the long-finger) then the cross-ratio of these three consecutive limb-lengths is (a+b)*(b+c)/(a+b+c)/b and the value is more or less constant over time, individual and even limb (fingers, toes, legs). Moreover, the common value, called the golden wurf, was conjectured to be one half of the square of the golden ration, which is about 1.31. I have, together with Jun Udagawa, Sven-Erik Hänel, and Hiroki Otani, investigated these remarkable suggestions of Pethukov's from a couple of different view-points. Three general questions when it comes to investigate so called invariances in biology are: (i) How much variance can we allow to still call it an invariant? (ii) How to express the "built-in-robustness" in the suggested quantification? (iii) When looking long enough (as we tend to do on the human body) on a, more or less stochastic, constellation, how many "invariances" are we expected to find?