# Gaussian Markov Random Fields: Theory and Applications

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In this series of talks I will discuss Gaussian Markov random fields (GMRFs) and some of its applications in statistics. At first sight, this seems to be a rather specialised topic, as the wider class of Markov random fields is probably known only to researchers in spatial statistics and image analysis. However, GMRFs have applications far beyond these two areas, for example in structural time-series analysis, analysis of longitudinal and survival data, spatiotemporal statistics, graphical models, and semi-parametric statistics.

Despite the wide range of application, there is a unified framework for both representing, understanding and computing with GMRFs using the graph formulation. In this series of talks I will discuss the main properties of GMRFs, emphasise the strong connection between GMRFs and numerical methods for sparse matrices, and outline various applications of GMRFs for statistical inference.

The outline of the talks is as follows.

1. Definition and basic properties of GMRFs. Simulation algorithms for GMRFs.

2. Numerical methods for sparse matrices. Intrinsic GMRFs and hierarchical GMRF models.

3. Case studies and MCMC algorithms. Some more advanced topics.

The talks are based on the book

```
@book{GMRFbook,
    AUTHOR = {H. Rue and L. Held},
     TITLE = {Gaussian {M}arkov Random Fields: {T}heory and Applications},
    SERIES = {Monographs on Statistics and Applied Probability},
    VOLUME = {104},
 PUBLISHER = {Chapman \& Hall},
   ADDRESS = {London},
      YEAR = 2005
}
```

See also `http://www.math.ntnu.no/~hrue/GMRF-book` for additional information about the book, and `http://www.math.ntnu.no/~hrue/GMRFLib` for the `GMRFLib` library (free software) for doing computing with GMRFs.