STOCHASTIC ANALYSIS OF FERROMAGNETISM

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IPHD16020

Abstract: In this talk, I will discuss the research problems that constitute my doctoral thesis. I will speak of two models (Landau-Lifshitz-Gilbert (LLG) equation and the Landau-Lifshitz-Bloch (LLB) equation), both used to model the phenomenon of ferromagnetism. In particular, we have considered the stochastic counterparts of the said models as an attempt to study thermal fluctuations within the material.

In the first part, we consider the stochastic LLB equation, driven by a real valued Wiener process. We show Wong-Zakai type approximations, showing that the solution depends continuously on the Wiener process driving it. A main ingredient of the proof is using a Doss-Sussmann type transform to convert the stochastic partial differential equation into a deterministic equation with random coefficients.

We follow this up by considering the stochastic LLB equation, driven by a Lévy process with pure jump. We show that the problem admits a strong (in the probability sense) solution. Further, we establish a Freidlin-Wentzell type large deviations principle for the small noise asymptotic of solutions. For this, we adopt a weak convergence approach.

In the last part of this talk, I will describe a couple of optimal control problems that we have considered. First, we add an external control to the effective field for the stochastic LLB equation. We use the technique of relaxation to expand the space of admissible solutions. We show that the problem admits a relaxed optimal control. In the second essay, we add an external control, this time to the effective field for the stochastic LLG equation. We first show that the problem admits a strong (in the probability sense) solution, which also enjoys maximal regularity properties. Then we show that for a natural cost functional, the problem admits an optimal control.