

Taming Uncertainty and Profiting from Randomness

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Abstract. The title of this talk is a short form of the title of a major research project (a so-called Collaborative Research Centre, funded by the German Research Foundation, DFG), currently running at Bielefeld University. This project is based on the claim that randomness, which is ubiquitous and cannot be avoided in mathematical modelling, neither in the natural sciences, nor in the humanities, has in fact two “faces”: One is a kind of a nuisance, which destroys one’s observations or measurements, is hard to quantify and causes uncertainty about the correctness of one’s final conclusions. So, one has to look for means for “taming” it and to develop corresponding mathematical tools. On the other hand, in many cases randomness can help to understand observed phenomena, which otherwise would remain a mystery. In addition, its mathematical analysis may lead to a deeper understanding of the underlying mechanisms, thus leading to resolving seemingly contradictory conclusions from the theoretical and the experimental outcomes respectively. The latter is with no doubt a valuable “profit”.

In the talk I shall present some examples for the above claim and try to explain what, in particular, stochastic analysis, offers for “taming uncertainty” as well as for “profiting from randomness”. One eminent instance for both the latter will be the mathematical approach to understanding and analysing dynamical processes under the influence of “noise”, which led to the development of the field of “stochastic partial differential equations”. But despite this for non-experts maybe not so attractive and too technically sounding term, I think these and their usefulness can be understood quite well on an intuitive level from an appropriate view point, as I shall try to explain in the talk.