

Dimension Dependent Weak-Type (1,1) Estimates in Harmonic Analysis and AI

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At the 1986 International Congress of Mathematicians, E. M. Stein presented on a program he had been developing for several years on infinite-dimensional harmonic analysis. The theme of this program is to establish estimates for various operators, e.g. the Hardy-Littlewood maximal function, Riesz transforms, Littlewood-Paley g -function, where the constants do not depend on the dimension. In the proceedings of the conference, he mentions several open problems, including the question of whether the Riesz transforms and Hardy-Littlewood maximal function admit dimension-free weak-type (1,1) estimates. Recently, in collaboration with Lance Ouyuan and Cody Stockdale we obtained a resolution of one of these questions and an improvement on the state of the art for the other. One key new idea in these proofs is partial balayage, which was discovered through interactions with an LLM. In this talk we discuss some of the history of the problems, as well as our use of AI to resolve them.