Mathematical Physics Studies

Fumio Hiai

Quantum *f*-Divergences in von Neumann Algebras

Reversibility of Quantum Operations

Springer

1st ed. 2021, X, 194 p. 139 illus.

Printed book

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Quantum f-Divergences in von Neumann Algebras

Reversibility of Quantum Operations

Series: Mathematical Physics Studies

- **Presents a general and rigorous framework of quantum information based on von Neumann algebras**
- **Makes a comprehensive study of different types of quantum divergences**
- **Updates Petz' previous work on reversibility/sufficiency for quantum operations**

Relative entropy has played a significant role in various fields of mathematics and physics as the quantum version of the Kullback–Leibler divergence in classical theory. Many variations of relative entropy have been introduced so far with applications to quantum information and related subjects. Typical examples are three different classes, called the standard, the maximal, and the measured f-divergences, all of which are defined in terms of (operator) convex functions f on (0,) andhave respective mathematical and information theoretical backgrounds. The -Rényi relative entropy and its new version called the sandwiched -Rényi relative entropy have also been useful in recent developments of quantum information. In the first half of this monograph, the different types of quantum f-divergences and the Rényi-type divergences mentioned above in the general von Neumann algebra setting are presented for study. While quantum information has been developing mostly in the finite-dimensional setting, it is widely believed that von Neumann algebras provide the most suitable framework in studying quantum information and related subjects. Thus, the advance of quantum divergences in von Neumann algebras will be beneficial for further development of quantum information. Quantum divergences are functions of two states (or more generally, two positive linear functionals) on a quantum system and measure the difference between the two states. They are often utilized to address such problems as state discrimination, error correction, and reversibility of quantum operations.

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