

Report on the habilitation thesis, *Quantum Walks*, by Martin Štefaňák

The first appearance of something like a quantum walk appears in the checkerboard model of Feynman and Hibbs. The modern study dates back to a paper by Aharonov, Davidovich and Zagury in 1993, but interest in the field increased significantly with a paper by D. Aharonov, A. Ambainis, J. Kempe, and U. Vazirani in 2001. There it was proposed that quantum walks could be useful in finding quantum algorithms, which could eventually be implemented on a quantum computer. Since then, the field has moved along steadily, with progress on both the theoretical and experimental fronts. This history is summarized nicely in the Introduction of the thesis (though the paper by D. Aharonov et al. in Proc. 33rd STOC, pages 50-59, New York, NY 2001 ACM should be mentioned).

The thesis presents, in its second chapter, a review of the coined quantum walk on a line, where the coin has two states. In the next chapter, this is extended to a three-state coin, which leads to a discussion of trapping states. The role of trapping states when there is an absorbing vertex is also discussed. The final chapter is on state transfer, in which a quantum walk is used to deterministically transfer a walker from one vertex of a graph to another. This also entails a short review of quantum walk search algorithms, which are closely related to state transfer.

For the most part, the work on the thesis is focussed on the properties of quantum walks rather than their application. Perhaps a direction for future work would be to look into using what has been learned here for an algorithm. For example, with state transfer, if there are defects that prevent it, then it could be used to detect the presence or absence of those defects.

The thesis is well-written, and based on seven years of work by Dr. Štefaňák and his collaborators. It certainly is more than enough to justify the award of a habilitation to Dr. Štefaňák. According to Google Scholar, Dr. Štefaňák has an h-index of 14, which is quite respectable for someone in the early stages of a career. It also indicates that the work in the habilitation thesis has attracted attention.