

## The Unreasonable Effectiveness of Moore-Shannon Hammocks

The title borrows from that of the 1960 article “The Unreasonable Effectiveness of Mathematics in the Natural Sciences” by celebrated Physicist Eugene Wigner, which reflects on the uncanny ability of Mathematics to explain natural phenomena, and even to make predictions that are later confirmed empirically.

In 1956, in their article “Reliable circuits using less reliable relays”, E. F. Moore and (the famous) C. E. Shannon proposed a solution to the problem of unreliable switching devices. They planned to exploit redundancy to gain reliability; not at the level of gates, as in Von Neumann’s then recent designs (multiplexing etc), but at the level of devices. They demonstrated that their approach might be superior to Von Neumann’s in certain ways. In doing this, they invented, or discovered, a large and interesting family of graphs that, to our knowledge, has not been investigated other than in the work of Valeriu Beiu and his team, to which we belong. Among this vast family (whose size it seems they might have greatly underestimated in 1956) Moore and Shannon chose essentially only one design: The Hammock. Intriguingly, they gave no justification for this design, yet in all of our studies so far it has defeated all comers, and remains the reigning champion ! The hammock is particularly interesting in terms of its information-theoretic properties, that is, in its behaviour as a discrete, memoryless binary channel with noise. Historically, this puts the hammock in a very nice setting: Shannon’s seminal article “A Mathematical Theory of Communication” came out just two years after “Reliable circuits”, in 1948; his (justly) more confidently-titled book “*The Mathematical Theory of Communication*” followed in 1949 (my italics). In this presentation I will introduce the problem, describe some of our results to date, and try to give an idea of where we hope this interesting topic might lead us in future; in particular how it might be applied to modern-day challenges.



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