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Quantum Error Correction: Optimal, Robust, or Adaptive? Or, Where is The Quantum Flyball Governor?[1] ROBERT KOSUT, SC Solutions, MATTHEW GRACE, Sandia National Laboratories — In *The Human Use of Human Beings: Cybernetics and Society* (1950), Norbert Wiener introduces feedback control in this way:

> "This control of a machine on the basis of its actual performance rather than its expected performance is known as *feedback* ... It is the function of control ... to produce a temporary and local reversal of the normal direction of entropy."

The classic classroom example of feedback control is the all-mechanical flyball governor used by James Watt in the 18th century to regulate the speed of rotating steam engines. What is it that is so compelling about this apparatus? First, it is easy to understand how it regulates the speed of a rotating steam engine. Secondly, and perhaps more importantly, *it is a part of the device itself.* A naive observer would not distinguish this mechanical piece from all the rest. So it is natural to ask, where is the *all-quantum* device which is self regulating, ie, the Quantum Flyball Governor? Is the goal of quantum error correction (QEC) to design such a device? Devloping the computational and mathematical tools to design this device is the topic of this talk.

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