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On the Influence of Coding on the Mean Time to Failure for Degrading Memories with Defects

Han Vinck and Karel Post
Eindhoven University of Technology
Eindhoven, POB 513, The Netherlands

We study the application of a combined test- error-correcting procedure to improve the Mean Time to Failure (MTTF) for degrading memory systems with defects (hard errors). The degrading is characterized by the probability p that in a unit of time a memory cell turns over from the correct physical state to the permanent defect state. We give bounds on the MTTF and show that coding gives an improvement in performance proportional to $N^{(d_{min}-2)/(d_{min}-1)}$, where d_{min} is the minimum distance of the code used and N the size of the memory in words. For small probabilities p, the MTTF is proportional to $N^{-1/(d_{min}-1)}$. Thus the time gain for a simple minimum distance 3 code is proportional to $\sqrt{N}$. In addition we combine a memory-word-test with a simple defect-matching code. This method enables reliable operation with one defect in a word. The code efficiency is $(n-2)/n$. where n is the word length.