Hanging in the error balance

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Most computing systems today are power limited. This is true all the way from battery operated edge devices to the top supercomputers of the world. Current trends in computer architectures therefore favor computation with low precision arithmetic which consumes less power, allows higher throughput, and reduces the amount of data that must be moved through the memory hierarchy. Unfortunately, ill-conditioned problems are often intractable in very low precision using standard methods. As a result, much research over the years has focused on algorithms using mixed-precision computation, with most operations performed in low precision while select operations use higher precision. However, not every problem is created equal and what constitutes sufficient high or low precision is problem dependent. In this talk I will focus on the notion of ”error balance” as a critical tool to select precision levels, and extend the traditional notion of mixed-precision to ”progressive precision” where the various precision levels are allowed to increase with each new level in a multigrid hierarchy. While progressive precision is most readily applicable for multigrid solvers, most of the talk is broadly applicable regardless of choice of solver.

References:

[1] https://doi.org/10.1137/20M1348571

[2] https://doi.org/10.1137/20M1349230

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