A minimal communication approach to parallel time integration

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We explore an approach due to Nievergelt of decomposing a time-evolution equation along the time dimension and solving it in parallel with as little communication as possible between the processors. This method computes a map from initial conditions to final conditions locally on slices of the time domain, and then patches these operators together into a global solution using a single communication step. A basic error analysis is given, and some comparisons are made with the parareal method of Lions, Maday and Turinici. Based on the assumption that parallel computation is cheap but communication is very expensive, it is shown that this method can be competitive. We do numerical simulations on hundreds of processors for a variety of problems to show the practicality and scalability of the proposed method.