

*Abstract*— Despite the growing interest in asynchronous circuits, *programmable* asynchronous controllers based on the idea of *microprogramming* have not been actively pursued. Since programmable control is widely used in many commercial ASICs to allow late correction of design errors, to easily upgrade product families, to meet the time to market, and even effect run-time modifications to control in adaptive systems, we consider it crucial that self-timed techniques support *efficient* programmable control. This is especially true given that asynchronous (self-timed) circuits are well suited for realizing reactive and control-intensive designs.

We offer a *practical* solution to programmable asynchronous control in the form of application-specific microprogrammed asynchronous controllers (or *microengines*). The features of our solution include a modular and easily extensible datapath structure, support for two main styles of handshaking (namely two-phase and four-phase), and many efficiency measures based on exploiting concurrency between operations and employing efficient circuit structures. Our results demonstrate that the proposed microengine can yield high performance—in fact performance close to that offered by automated high-level synthesis tools targeting custom hard-wired burstmode machines.