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Christoph Saas

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In a number of applications the dominant part of the energy consumption is associated with the charging and discharging of dominant capacitances. Adiabatic switching is a method to reduce the dynamic energy dissipation during charging and discharging of a capacitance. However, some overhead is required to achieve adiabatic behavior in complex logic blocks.
In this work adiabatic principles are implemented in to two applications in which a dominant capacitance has to be charged. As the adiabatic switching is limited to the driver itself, a low logic complexity in the adiabatic circuit is achieved. The dominant energy dissipation associated with the charging of the capacitance allows for some overhead in the controlling circuits.
In part I adiabatic drivers are presented to charge the parasitic capacitance at the output of integrated circuits. This inherently includes charging a load capacitance up to the full supply voltage in a given time. A highly efficient resonant circuit is used to approximate the oscillating supply voltage. The driver is implemented as a multistage driver to efficiently charge and discharge parasitic capacitances of the controlling circuitry.
In part II the column lines of a flat panel display are adiabatically charged to their final voltage level. In this application the final output voltage is data-dependent. Energy efficient charging is implemented by a stepwise approximation of the adiabatic ramp. This allows for easy realization of the different voltage levels. A hybrid solution is proposed to increase the bit depth while maintaining a low overhead.
The energy performance of both proposals seems very promising. However, external elements are needed to temporarily store energy. It strongly depends on the overall system specification if the implementation overhead is justifiable by the achievable energy savings.