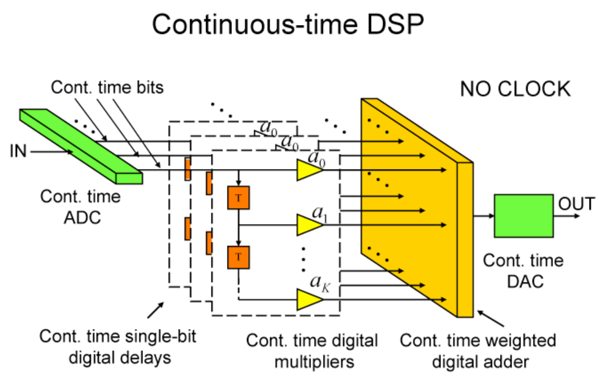
NSF Funds Ultra-Low Energy Circuits



The National Science Foundation has awarded a $1 million grant to Professors Yannis Tsividis (http://www.ee.columbia.edu/fac-bios/tsividis/faculty.html) of electrical engineering (http://www.ee.columbia.edu/) (principal investigator) and Steven Nowick (http://www.cs.columbia.edu/%7Enowick/) of computer science (http://www.cs.columbia.edu/) (co-principal investigator). Tsividis is the Batchelor Memorial Professor of Electrical Engineering and Nowick is professor of computer science and electrical engineering, and chair of Columbia's Computer Engineering Program (http://www.compeng.columbia.edu/) .

The grant will fund their proposal to perform research in ultra low-power microelectronic systems, which perform continuous monitoring, acquisition and processing of signals occurring in the physical world (see diagram at right). Such systems can be used in a wide range of applications, from environmental sensors to implantable or ingestible biomedical devices. This interdisciplinary research combines the expertise of the two investigators in continuous-time digital signal processors and in asynchronous digital design.

The proposal, titled "Power-Adaptive, Event-Driven Data Conversion and Signal Processing Using Asynchronous Digital Techniques," addresses the increasing demand for ultra low-power and high-quality microelectronic systems that continuously acquire and process information as soon as it becomes available. In these applications, new information is generated infrequently, at irregular and unpredictable intervals. This event-based nature of the information calls for a drastic re-thinking of how these signals are monitored and processed.

The professors explain that traditional synchronous (i.e., clocked) digital techniques, which use fixed-rate operation to evaluate data whether or not it has changed, are a poor match for these applications, and often lead to excessive power consumption. This research aims instead to provide viable "event-based" systems: controlled not by a clock but rather by the arrival of each event. Asynchronous (i.e., clockless) digital logic techniques, which are ideally suited for this work, are combined with continuous-time digital signal processing, to make this task possible.

Such continuous-time data acquisition and processing promises significant power and energy reduction, flexible support for a variety of signal processing protocols and encodings, high-quality output signals, and graceful scalability to future microelectronic technologies. A series of silicon chips will be designed and fully evaluated, culminating in a fully programmable, event-driven data acquisition and signal processing system, which can be used as a test bed for a wide variety of real-world applications.

Posted: May 27 2010