## AUTHOR COMMENTARIES - 2008

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### Dr. Steve Beeby

Featured Scientist from *Essential Science Indicators*SM

*According to a recent analysis of* Essential Science Indicators *from Thomson Reuters, the work of Dr. Steve Beeby has moved into the top 1% in the field of Engineering. His current record in this field includes 38 papers cited a total of 251 times between January 1, 1998 and June 30, 2008. He also has a dozen additional papers in other fields in the database.*

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*Dr. Beeby is a Reader in the Electronic Systems & Devices Group of the School of Electronics and Computer Science at the University of Southampton in the UK.*

***In the interview below, he talks with* ScienceWatch.com *about his highly cited work in Engineering.***

**SW: Please tell us a little about your research and educational background.**

I obtained a BEng Honours degree from the University of Portsmouth in 1992 and a Ph.D. from the University of Southampton in 1997. My Ph.D. research was on the topic of micromachined silicon resonators, which provided an excellent foundation in micromachining processes, micromechanical structures, and MicroElectroMechanical Systems (MEMS) technologies in general.

I subsequently became involved in the development of smart materials (primarily for MEMS applications) and their deposition by screen printing. More recently I have led research activities at Southampton into vibration energy harvesting.

*"Prosthetic limbs will without doubt become more functional in the next few years."*

**SW: What do you consider the main focus of your research, and what drew your interest to this particular area?**

Currently the main focus of my research is vibration energy harvesting. This draws upon aspects of smart materials, electromagnetics, and microfabrication processes and is a "hot" research topic at present. I was lucky to be involved in this research at a very early stage (our first work at Southampton started in 1998) and it is an exciting area to work in that leads to many practical opportunities with external companies.

**SW: One of your most-cited papers in our database is the 1999 *Journal of Micromechanics and Microengineering* article, "Processing of PZT piezoelectric thick films on silicon for micromechanical systems." Would you walk our readers through this paper and its findings?**

This paper considered the possibility of combining screen-printed thick-film piezoelectric layers with

micromachined silicon structures for use in MEMS. It was an extensive practical exploration of the compatibility of micromachining process with the deposited films. This included common wet and dry etching processes and also investigated the influence of the high firing temperature required for the piezoelectric film on the silicon substrate and common electrode materials. This work identified a fabrication process flow that does enable screen-printed piezoelectric films to be used in MEMS as was demonstrated in subsequent publications.

**SW: Another of your highly cited papers is the 2004 *Sensors and Actuators A-Physical* paper, "An electromagnetic, vibration-powered generator for intelligent sensor systems." Would you please talk a little about this paper and its significance for the field?**

*"Currently the main focus of my research is vibration energy harvesting."*

Our initial work at Southampton on vibration energy harvesting was based upon piezoelectric thick-films but this did not deliver much power. We went on to explore electromagnetic transduction mechanisms that are more efficient at converting mechanical energy into electrical. This early paper describes the design and performance of an electromagnetic circuit and mechanical structure that together leads to an improved generator design with significantly more output power. This work led to the formation of a spin-off company from the University, called Perpetuum Ltd.

**SW: A couple of your papers discuss designs to improve the functionality of a prosthetic hand device. Would you talk a little about this aspect of your research?**

Again this relates to screen printed thick-film sensors. Using the screen-printing technology is a simple way of fabricating an array of sensors that can detect grip force, object slip and temperature. The resulting instrumented fingertip is very robust, low cost, and provides additional functionality to the prosthetic hand. This functionality includes the automated adjustment of grip should an object being held start to slip, and provides a degree of control over grip force to help prevent fragile object being broken.

**SW: Where do you see this research going in five to ten years?**

Prosthetic limbs will without doubt become more functional in the next few years. Time will tell if the thick-film sensors we demonstrated will be exploited further but they certainly looked promising.

**Dr. Steve Beeby**
**Electronic Systems & Devices Group**
**School of Electronics and Computer Science**
**University of Southampton**
**Southampton, UK**

**Steve Beeby's current most-cited paper in *Essential Science Indicators*, with 38 cites:**

Glynne-Jones P, *et al.*, "An electromagnetic, vibration-powered generator for intelligent sensor systems," *Sensor Actuator A-Phys*. 110(1-3): 344-9, 1 February 2004. Source: *Essential Science Indicators* from Thomson Reuters.

Keywords: micromachining processes, micromechanical structures, MEMS technologies, vibration energy harvesting, screen printed piezoelectric films, electromagnetic transduction mechanisms, prosthetic limbs.

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