



Simon Louwsma

His analog-to-digital converter is among the fastest in the world, and also consumes little energy. Simon Louwsma even has difficulty finding test equipment fast enough to keep up with his circuit. He himself is also setting the pace: he and a few others have started their own circuit design company.

World class circuits

"A great deal happens on the analog-digital interface, which is why we at Axiom IC are focusing on this specific area. And my doctoral research also deals with this interface: I have designed an analog-to-digital converter that is both ultra fast and energy-efficient. Circuits of this kind are needed everywhere. Radio signals arrive at a mobile phone antenna in analog form, as waves. They have to be converted into the digital domain, so that the computer in the phone can process them. Later, the signals have to be transformed back into our analog world, in the earpiece, for example, and this requires conversion in the opposite direction. The number of standards and radio frequency bands used by mobile devices is expanding. This suggests the application of 'software-defined radios', which also need fast A-D conversion. Or consider television: if you could digitize fifty TV channels at once, rather than just one, you could then unleash digital techniques and software on them. My circuit is ready for this challenge."

"The traditional fast ADC solution uses a lot of energy. Achieving 10-bit accuracy now needs 1024 comparators, each handling a small part of the signal. I use a single comparator that does the same job in just ten steps, which is far more efficient, if a little slower. But I can recover the speed by running sixteen in parallel, and still come out on top. I also exploit digital logic so as to unburden the analog electronics. This adds more speed, but involves hardly any extra chip area. Techniques of this kind are not yet common in the industry. They call for a new way of thinking. The industry has too much of a tendency to keep on trying to improve existing concepts. This avoids unnecessary risk, but cannot lead to really innovative solutions. However, innovation is essential, particularly in view of the ever higher requirements."

'I have designed an analog-to-digital converter that is both ultra fast and energy-efficient.'

"The entire circuit fits inside a square with sides of two millimetres. What if you were to magnify this area one million times - the sides of the square would then be two kilometres long, with myriad paths running through it, just twenty centimetres wide, and the structure would be six layers deep. There would be many connections joining the layers, with the active elements on the ground floor, no bigger than a carton of milk. A construction of this complexity, and as big as a city centre, is hard to imagine! When one of these circuits comes back from the semiconductor plant, you are always waiting with bated breath to see if it works. And, for my converter,

you also need extremely expensive measuring equipment to keep up with the speed. Twenty gigabits a second really is an awful lot! We have presented this converter to people who have been working in the field for years. The concept we have developed for achieving high time-accuracy is extremely simple, whereas they use a complicated "factory", which also uses a great deal of energy. They had never dreamed it could be so simple. This is also one of the enjoyable aspects of PhD research: being able to present your solutions to such a distinguished audience. Our client, NXP Semiconductors, is also enthusiastic, and has applied for four patents for my circuit."

"Last summer I set up the company Axiom IC together with my fellow PhD student Daniel Schinkel and three other highly experienced people, including part-time professor Ed van Tuijl. We provide advanced design services to other companies, mainly on AD and DA conversion. Further into the future, we are also planning to develop our own intellectual property (IP), and perhaps later even our own chips. There is definitely a market for what we provide, and we have no shortage of orders. We are therefore also able to be selective and to specialize, and we are not obliged to accept everything that comes along. It goes without saying that we have excellent relations with Prof. Bram Nauta's IC Design group, and Daniel and I are part of the University of Twente TOP scheme for starting entrepreneurs. All we have to watch out for now is that the business does not get in the way of our PhD research too much."