SR Motors...Sinking Relevance or Suddenly Respectable?

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So what's going on with the Switched Reluctance motor? Everywhere I go, I see engineers huddled together in dark corners at parties or sporting events, speaking in hushed whispers, asking this question. However, nobody wants to speak too loudly for fear that their credibility as a motor control engineer will be shot. Everybody remembers the colossal disappointment from the SR promises made to us in the mid 90's. Most of this disappointment can be attributed to the fact that this motor was WAY over-marketed and over-hyped. The SR motor was portrayed as "the little motor that could". It was placed upon a white horse and ascribed such status that NO motor could ever live up to these expectations.

To be honest, I feel kind of sorry for this little motor, which has been waiting for its moment in the spotlight for over 150 years. To be sure, it comes with some baggage, and many of the problems which torpedoed its success in the 90's are still valid today. For one thing, its incredible flexibility is actually a disadvantage, as it makes it difficult to establish a standard drive topology for this motor. Three-phase, four-phase, and other topologies are all possible, and no configuration has emerged yet as a clear winner. Also, unlike every other magnetic motor, it is incompatible with the ubiquitous totem-pole half-bridge power stage, which just about every integrated PWM module today is designed to work with. Finally, it squeals like a stuck pig when it's running, especially under load. Many companies in the 90's quickly filed patents to mitigate this effect by using special current wave-shaping techniques, but none were effective in making it as quiet as other non-salient topologies.

On the other hand they are cheap. ...REALLY cheap! A study from a large manufacturer of SR and ACIM motors in the 90's claimed that the manufacturing costs for an SR motor are 10% lower than that of an AC induction motor of the same horsepower rating. That's a pretty significant statement considering that the ACIM has over a hundred years of manufacturing infrastructure standing behind it, but the SR motor has almost no manufacturing infrastructure (yet). But there are other compelling reasons why the time may be right for the SR motor to mount a comeback:

1. Neodymium prices are skyrocketing. Cheap neodymium was the final nail in the coffin for SR motors in the late 90's. In 2003, the market cost of raw Nd was $8/kg. At the time of this writing, it is hovering around $340/kg! One source points to the fact that China controls 97% of the world's Neodymium supply, and they have apparently figured out that they have a monopoly on the market. Other mines are reopening to respond to this demand, but that takes time. The clear losers are high horsepower BLDC and PMSM motors, where the cost of the magnetic material is a high percentage of the motor cost. For example, scuttlebutt has it that the next model year Prius will be powered by an AC Induction motor, just like the Tesla

Roadster is today. Like its ACIM distant cousin, the SR motor has NO permanent magnets. And at high speeds, the efficiency can exceed that of even PMSM motors! There has been a lot of discussion recently as to whether the SR motor would make an attractive alternative for traction drives in electric vehicles.

2. Processor prices are collapsing. The doubly salient design of the SR motor results in a very nonlinear torque response, which requires more MIPS to control it properly. As the MIPS/$ ratio continues to rise, the prospect of achieving smooth SR motor control is more affordable now than ever before.

3. Renewed focus on safety. As electric motors continue to establish dominance in the automotive space, concerns over safety and robustness are becoming more prevalent. The SR motor is extremely simple, and for that reason, it is extremely hard to break. In fact, with some SR motor topologies, you can blow out a whole phase of the SR motor winding and/or the drive electronics, and the motor will continue to function! Such fault tolerance is almost irresistible for designers of safety critical systems, such as electric power steering.

So, will the SR motor rise again? It's anybody's guess, and really depends on several market factors. If we see a repeat of the marketing strategies that we saw in the 90's, its chances for popularity are diminished. While this is a good little motor which is well suited to lots of tasks, it is NOT the super-motor it was portrayed to be in the 90's. If this point is recognized and designers are willing to live with (or design around) its little quirks, I predict the SR motor will indeed experience slow but steady growth for years to come.

So what do you think? Do you have design plans which involve an SR motor? Does it make sense for TI to invest development dollars on ways to better control this motor?

I'm listening... :-)