Discussion of "Regenerating-Mode Low-Speed Operation of Sensorless Induction Motor Drive With Adaptive Observer"

M. Depenbrock and A. Steimel

With great interest, we read the above paper.' Two main problems have to be solved to identify speed in the whole range of Operation: l) the instability at low speed in the generating mode has to be removed and 2) the problems in the region around Stator frequency zero have to be treated. Both aspects are known and solutions have been found, published, and introduced into industrial products.

The detection of the instability in the regenerative region was described several times before, e.g., by[l] and [2]. Furthermore, different methods to completely remove this instability have been published [3], [4].

Without using nonlinear effects äs saliencies or slotting the only solution to completely overcome the problem of Stator frequency zero is to avoid Operation in the vicinity ofthis frequency. This solution is now proposed by Kubota *et al.* However, it has already been published by our working group [5]-[7].

Furthermore, a fully functional laboratory setup (test drive in the 100 kW ränge) was, for example, presented to the IEEE Joint IAS/PELS German Chapter at its meeting on June 2000 in our laboratory (http://www.ewh.ieee,org/r8/gemiany/ias-pels/pdf/Vl.pdf and .. ./V2.pdf, in German).

Our solution is protected by the German Patent 19913624.6 (priority 25.03.1999) and has been realized successfully on several prototype light rail and mass transit vehicies of Siemens Transportation Systems.

Although Kubota *et al.* do not expressively claim novelty, credit should be given to the first—and industrially successfui—realization of the described procedure.

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Closure to Discussion of "Regenerating-Mode Low-Speed Operation of Sensorless Induction Motor Drive With Adaptive Observer"

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On behalf of all the authors, I offer the following comments concerning the discussion of our paper' by Dr. M. Depenbrock and Dr. A. Steimel.

With regard to the instability under regenerating condition, we proposed the structure which included a flux observer and a speed adaptive law for sensorless drives first time in 1991 [5]. In [5], we clearly mentioned that the flux observer with the speed adaptive law was stable if the observer gain was appropriate. This time, in 2001,[1] we have shown a concrete example for calculating the observer gain. References [2] and [3] deal with the observer with zero observer gain and consider improvement ofthe adaptive law for speed estimation, By the way, [l] was for a different sensorless approach.

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With regard to zero-frequency Operation, after I received the discussion of our paper, I read [4]. The idea is similar to that of our paper, so l should have referred to it in our paper. Now, I show some differences between them. For the method in [4], the controlling variable is the Stator frequency, and the flux amplitude becomes very low, o.g., 1/10 of the rated value. For the method mentioned in our paper, the controlling variables are the flux current and the torque current as usual for vector control drives, and the flux amplitude does not become so low, e.g., 1/1.4.

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