Response to "Comment on 'MEMS-based high speed scanning probe microscopy'" [Rev. Sci. Instrum. 81, 117101 (2010)]

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The comment adds valuable background information with respect to our paper[1] and further illustrates the importance of MEMS scanners in various SPM applications as well as the ongoing development efforts in this field in different research groups. The paper by Degertekin *et al.*[2] describes an interesting MEMS AFM scanner with readout and feedback. However, it also clearly states that "the device was not optimized for this experiment, and the sensor membrane acted as a lightly damped resonator rather than having a broadband frequency response that is ideal for fast interaction force measurements." Although in Ref. 3 Onaran *et al.* discussed how their device could be employed as a high-speed scanning system, the measurement bandwidth was still as low as 10 kHz due to the limitations they already discussed in Ref. 2. Whereas the mechanical resonance frequency of the device was reported to be above 500 kHz, the maximum line rate that was actually demonstrated in the paper was very low, 60 Hz, and it was stated that "the imaging bandwidth of the FIRAT probe system controller was about 6 kHz, limited by the complex dynamics of the air flow in and out of the etch holes on two sides of the membrane." In other words, although the high-speed possibilities have been recognized already in Refs. 2 and 3, they have definitely not been demonstrated in these publications.

We hasten to add that it is not at all straightforward to compare the speeds of scanning probe microscopes in terms of a single "figure of merit," such as an image rate or a tip velocity. In order to conduct a meaningful comparison, we summarize the performances of high-speed MEMS scanning devices with feedback operation in the table below.

Publication	Resonance frequency	Frame rate	Line rate	Tip speed	Comments
Onaran *et al.* (Ref. 3)	500 kHz	3.75 Hz	60 Hz	0.240 mm/s	16 lines per frame
Akiyama *et al.* (Ref. 4)	87 kHz	0.016 Hz	61 Hz	1.22 mm/s	256 lines per frame
Sarangapani *et al.* (Ref. 5)	420 kHz	No image shown	No image shown	>0.1 mm/s	Force/time curves; 1 kHz measuement rate
Disseldorp *et al.* (Ref. 1)	218 kHz	2 Hz	1.024 kHz	5 mm/s	512 lines per frame
Yamashita *et al.* (Ref. 6)	70 kHz (feedback bandwidth)	32.25 Hz	3,2 kHz		100 lines per frame; not MEMS scanning
Picco *et al.* (Ref. 7)		30 Hz	40 kHz		Flexure stage; not MEMS scanning
Picco *et al.* (Ref. 7)	32 kHz/100 kHz	1300 Hz	130 kHz		No feedback; x-axis scanning by tuning fork oscillation
Rost *et al.* (Ref. 8)	>64 kHz	200 Hz	1.131 kHz	0.3 mm/s	No MEMS scanning; STM

[1] E. C. M. Disseldorp, F. C. Tabak, A. J. Katan, M. B. S. Hesselberth, T. H. Oosterkamp, J. W. M. Frenken, and W. M. van Spengen, Rev. Sci. Instrum. **81**, 043702 (2010).
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