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Reply to "Comments on 'Combining Switched TMAs and FDAs to Synthesize Dot-Shaped Beampatterns"'

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THE main innovation contained in the letter "Combining Switched TMAs and FDAs to Synthesize Dot-Shaped Beampatterns" [1] lies in the consideration of frequency diverse arrays (FDAs) feeding networks made up of time-modulating switches (hence the term TMA-FDA) instead of phase shifters. This has the undoubted advantage of leveraging that RF switches have virtually zero insertion loss while offering high angle resolution and cost-efficiency.

Obtaining quasi-static radiation patterns with FDAs is not feasible according to the constraint previously published in [2] and reinterpreted later in [3]. Nevertheless, the time-variant nature of the radiation patterns synthesized with FDAs is a positive feature in applications where dot-shaped beam scanning comes into play [4].

Having this latter context in mind, we make the following considerations regarding the comparison raised in [5] between the dot-shaped patterns synthesized with FDAs and the radiation patterns of pulsed phased arrays:

- The minimum far-field distance for an antenna array with N elements spaced $\lambda_c/2$ apart (λ_c is the carrier wavelength) is given by the so-called Fraunhofer distance $r_{\text{far}} = (N-1)^2\lambda_c/2$ [6] and is of the order of a few meters. This means that there is a large number of practical situations where antenna arrays operate in the long-range regime and the distance run by the transmitted signal in the near-field region is negligible with respect to the corresponding maximum distance in a given whole range-angle sector.
- With respect to the instant when an FDA beampattern is generated, we next reflect verbatim the following comment in [3, Section IV.A]: "The essential point is that the time consumption has to be taken into account in the process where the newly generated signal is propagating to the target point." In fact, incorrect and correct diagrams taking into account the signal propagation time are also shown in such a work [3, Figure 5]. Hence, in order to achieve r_0 (i.e., $t_0 = r_0/c$), the propagation time of the transmitted signal must be taken into account.
- An alternative to the TMA-FDA is the pulsed TMA shown in Fig. 1. Pulsed TMA combines the advantages of the feeding network considered in [1] with the features presented in [5], basically:
  1) The undesired side lobes in range can be greatly reduced or even removed, and
  2) Although with Kaiser windows, the pulse width in the range dimension can be controlled in a versatile way with the TMA-FDA model in [1], in the proposed architecture shown in Fig. 1 such a control is even easier, since such a width in range is directly proportional to the duration of the applied pulse.

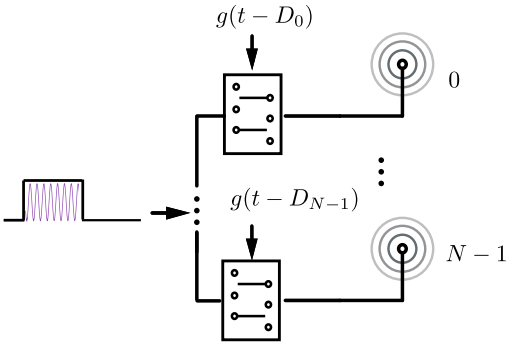

Fig. 1. Pulsed TMA to generate time-variant dot-shaped patterns.

In any case, the conclusion is that the core content and the contributions in [1] are still valid. We are very grateful to the author of [5] whose valuable comments have helped us to clarify our current work and to consider future research directions on approaching the FDA technique from a TMA perspective.

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