Clinical evaluation of coded excitation in medical ultrasound

Despite the enormous development in medical ultrasound (US) imaging over the last decades, penetration depth with satisfying image quality is often a problem in clinical practice. Coded excitation, used for years in radar techniques to increase signal-to-noise ratio (SNR), has recently been introduced in medical US scanning. In the present study, coded excitation using frequency-modulated US signals is implemented and evaluated in vivo. A total of nine male volunteers were scanned in three different abdominal locations, using both conventional pulsed and coded excitation. A modified scanner (B-K Medical model 3535) with transmitter and receiver boards developed in our group and a mechanical 4 MHz transducer were used. The system acquired coded and conventional US image frames interleaved, yielding identical acquisitions with the two techniques. Cine-loop sequences were evaluated by three experienced sonographers estimating penetration depth and scoring image quality of both conventional and coded imaging. The results showed a significant (p <0.001) increase in penetration depth around 2 cm. Image quality was significantly (p <0.001) better using codes at full usable depth and slightly, but also significantly (p <0.05), better above depths, where the effect of coded excitation was noticeable to the sonographers. We conclude that the higher SNR offered by coded excitation gives improved image quality and provides increased penetration in medical US imaging. This increased SNR can, alternatively, be used to allow imaging at higher frequencies and thereby increase spatial resolution without any loss of penetration. (E-mail: mhp@dadinet.dk)