Synthetic Aperture Beamforming in Ultrasound using Moving Arrays.

Medical ultrasound (US) is widely used because it allows cheap real-time imaging of soft tissue with no known side-effects or hazards to either patients or operating personnel. US has existed since the 1960s and was originally adapted from the concept of radar and sonar. The development in ultrasound has allowed the technology to evolve from a showing a simple echo along a line to fully visualize entire organs. The image changes significantly depending on the orientation of the transducer, making it more difficult to see exact features. This poses challenges since anatomy is three-dimensional and the limited view makes diagnosis of pathology difficult [1]. A full 3D volume acquisition makes it possible to capture larger areas at once, and also allows complete freedom in choosing the slice to view after the scan has been completed. This removes the need for doing additional scans if a significant slice was missed and allows a more precise measurement of organ dimensions [2, 3, 4]. Conventional 3D ultrasound imaging is basically faced with two limitations. It is only able to have a single transmit focus point and each line in a 3D volume has to be created independently. This reduces image quality outside the focus point and reduces temporal resolution. For better image quality it is desirable to achieve a good resolution at a large range of depths, and achieving a volume-rate fast enough to visualize the dynamics of the investigated organ. A method showing the possibility of meeting both these challenges is synthetic aperture focusing (SAF). A full dynamic focusing is possible in both transmit and receive as well as the possibility of imaging an entire volume with only a few emission. The resolution of the resulting volume can be improved by using more emissions, giving a trade-off between temporal and spatial resolution. A challenge with SAF is a large increase in processing requirements, especially for 3D systems. Ideally the method is able to achieve a good image quality for all depths in the volume with a time-resolution fast enough for cardiac images. This will allow better diagnoses with fewer scans, making each investigation less user-dependent. In the end this has the potential of reducing costs for each investigation, as both time required to scan, and the expertise needed to do so successfully can be reduced.

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