TOWARDS REAL-TIME THREE DIMENSIONAL ULTRASOUND ELASTOGRAPHY

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Methods for and limitations of $3D$ strain imaging with ultrasound (US) were investigated. The first part of this thesis presents the background for this problem (Chapter 1), and experimental methods developed in this work (Chapter 2–4). Chapter 2 describes different methods of obtaining $3D$ radiofrequency (RF) echo data with a commercially-available $1D$ mechanically rocked ("wobbler") array. (For simplicity, the acquisition of RF echo data from a $2D$ CMUT array transducer is described in Chapter 4). Chapter 3 describes the development a new strategy for volumes RF echo acquisition on a commercial US system that greatly reduces the amount of time required to acquire a data set. Chapter 4 describes the development of different types of $3D$ motion tracking and their respective merits. The second part of this thesis describes new simulation tools for optimization of investigational methods. Because of the large amount of RF echo data, and computational load, required for comparing $3D$ motion tracking algorithms, Chapter 5 discusses utilizing the computing power of a graphics processing unit (GPU) to create synthetic data that can be used for testing and comparing motion tracking algorithms under different conditions. Chapter 6 discusses using a GPU to increase the speed of $3D$ motion tracking. Elastically homogeneous phantoms as well as phantoms with a single spherical inclusion are investigated. Some initial simulation results involving the effect of lateral shear on motion tracking accuracy are given. Limited comparisons of motion tracking in *in vivo* RF echo data from breast tissues is also included. The thesis concludes in Chapter 7 with a discussion of some possible future work for further development.