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Ultralyd er et av de viktigste verktøyene leger bruker for å sjekke hjertet ditt. I enkelte tilfeller er det nødvendig å kombinere flere bilder for å forbedre medisinsk diagnostikk og terapi. Derfor har vi utviklet programvare og algoritmer som klarer bildefusjon mellom ekkokardiografi og gjennomlysning. Metodene kan brukes til planlegging av pacemaker implantasjon. Vi har også utviklet algoritmer for å muliggjøre bildefusjon mellom ekkokardiografi og datastyrt tomografi angiografi som et alternativ til invasiv koronar angiografi.

Cardiac ultrasound imaging (echocardiography) is one of the most valuable tools used in cardiology to evaluate the structure and function of the heart. The clinical applicability of the images can be improved by means of medical image fusion, an image processing technique to integrate multiple images in a common frame of reference. The combined knowledge can provide a better understanding of the underlying medical condition.

The main goal of this thesis is image fusion of echocardiography with other medical imaging modalities to improve diagnosis and facilitate image-guided interventions in cardiac diseases. The overarching idea is to combine knowledge on cardiac anatomy and function into a single augmented multimodality image, and thereby overcome difficulties caused by a time consuming and error-prone process of data integration when images are viewed side-by-side.

We present computer tools designed to provide fusion of X-ray imaging with functional information (obtained by echocardiography) to guide CRT implantation. Methods to derive 3D cardiac models that can be used in CRT and related interventional applications were also detailed and validated. Next, we show how the heart's surface can be registered to its matching coronary venous geometry. The implications of integrating the guidance tool into a routine clinical practice were also studied. The fusion workflow integration was demonstrated in two implantation labs (equipped with different X-ray imaging system).

Coronary artery disease (CAD) is caused by plaque deposition in coronary arteries producing a dangerous narrowing of the lumen. Existing standard for functional imaging in CAD is invasive coronary angiography, which is correlated with considerable risk of death and myocardial infarction. In contrast, we present methods to aid fusion of two non-invasive imaging modalities; coronary computed tomography angiography (CCTA) and 3D echocardiography (3DE). Three algorithms were compared and validated.