A COMPUTATIONAL METHOD FOR DETERMINING LEFT VENTRICULAR DIASTOLIC FIBER STRAIN RELATIVE TO A ZERO PRESSURE GEOMETRY

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I. INTRODUCTION

Abnormal cardiac fiber stretching has been shown to be related to the formation of arrhythmias. In this work we estimate this stretching relative to a pressure free state using a finite element model that has been calibrated to strain and pressure measurements in late diastole.

II. METHODOLOGY

The calibration of a finite element model to strain is formulated as an optimization problem whereby the distance between the simulated and measured strains is minimized by adjusting material parameter values. This minimization happens at every stage of a zero pressure geometry calculation algorithm [1] so that the resulting strains are relative to a pressure free state. Local myocardial fiber orientations are estimated by a rule based method [2]. The optimization problem is solved using a gradient based minimizer with an automatically derived adjoint equation [3].

III. RESULTS

Figure 1 shows an example fiber strain calculation.

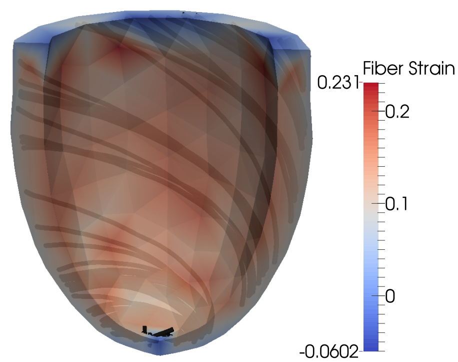

Fig. 1. Fiber strains simulated in an idealized geometry

IV. DISCUSSION

The proposed algorithm has the potential to estimate fiber strains independently of blood pressure. More testing and validation is needed to confirm this. Patient specific estimations can be performed using speckle tracking strain and pressure catheter data.

V. REFERENCES

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This work is supported by a Center of Excellence grant from the Research Council of Norway to the Center for Biomedical Computing at Simula Research Laboratory and the Center for Cardiological Innovation at Oslo University Hospital.

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