

Fully automatic AI-based valve motion parameter extraction on long axis CINE images – application on N=11000 patient datasets

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Declaration of interest

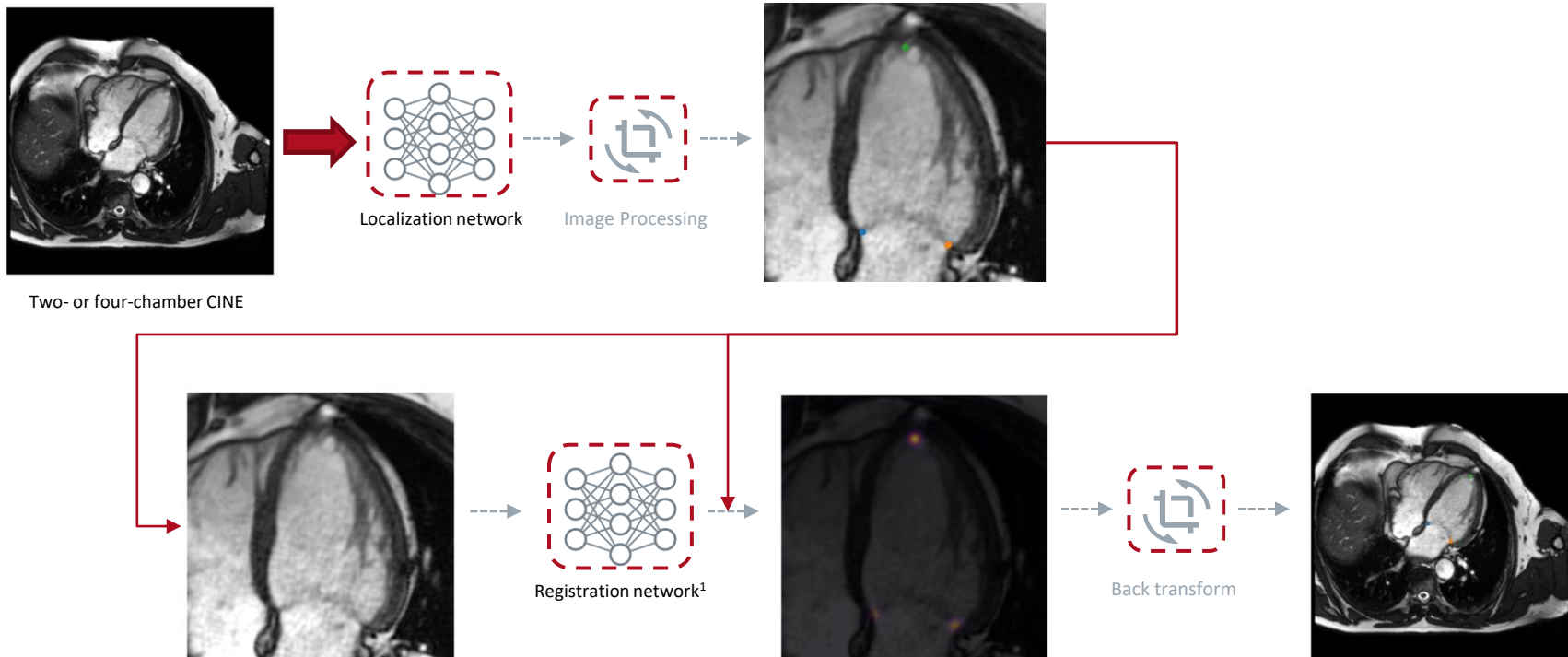
- **PhD stipend from Siemens Healthcare GmbH**



Introduction

- **CINE images may contain potentially clinically relevant parameters beyond typically extracted measures**
- **Manual extraction hampers their validation**
- **Fully automated DL-based motion parameter extraction system, applied to the mitral valve**

Methods



Parameters of interest

Atrioventricular plane *displacement* (AVPD):

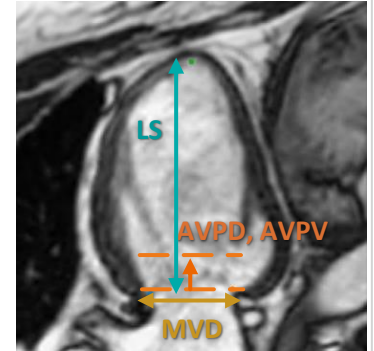
- Perpendicular distance of the MV plane from the first cardiac phase

Atrioventricular plane *velocity* (AVPV):

- Time-resolved discrete derivate of AVPD

Mitral valve *diameter* (MVD):

- Euclidean distance between MV insertion points



Mitral annular plane systolic excursion (MAPSE)¹

Longitudinal shortening (LS)²

Data sets

- **Training set**

- N = 166 multivendor, 1.5T & 3T
- Medical experts' ground-truth annotation
- Cardiac Atlas Project challenge datasets¹

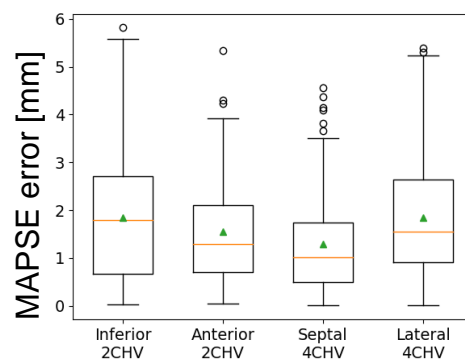
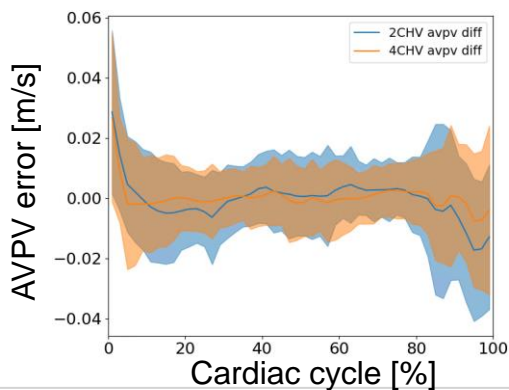
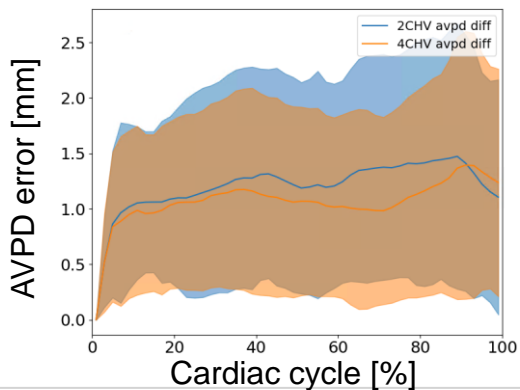
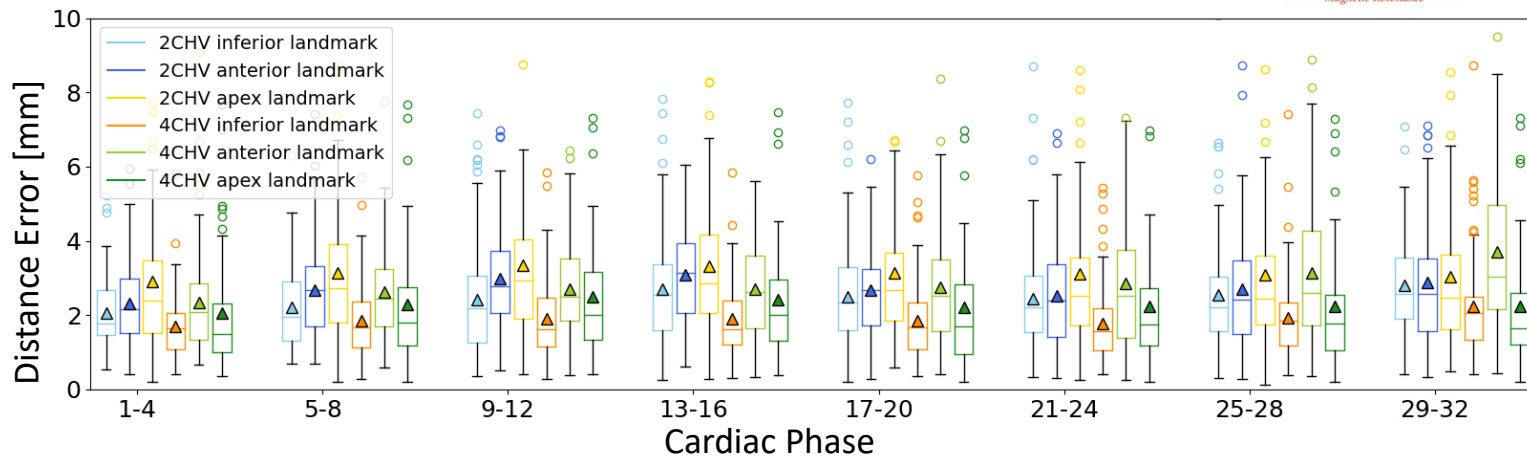
- **Test set**

- 11000 data sets acquired on 1.5T Siemens scanners²
- Single vendor, single institution

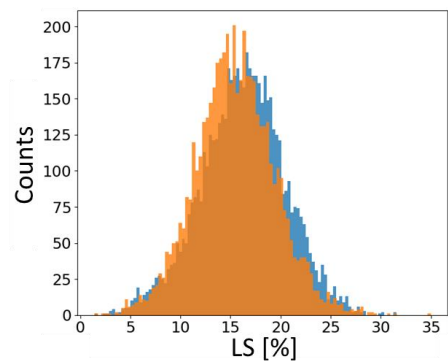
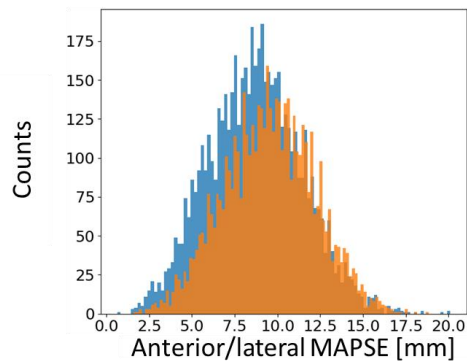
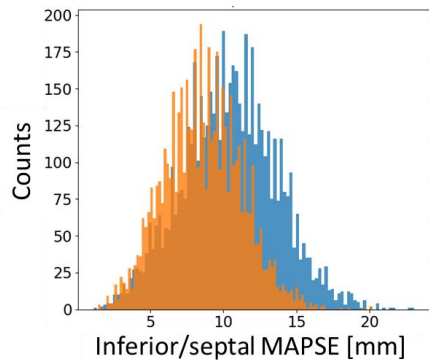
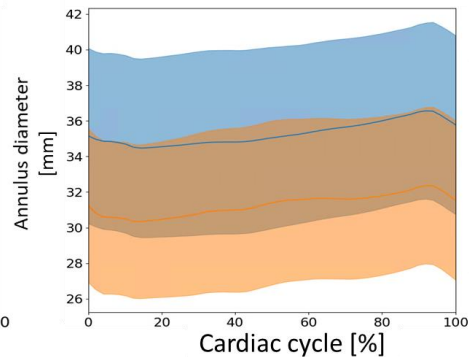
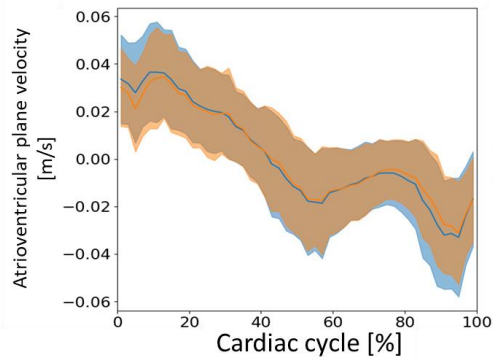
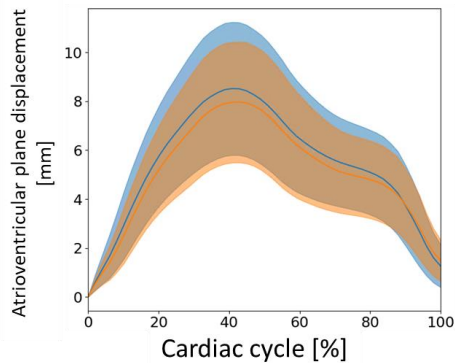
Evaluation

- **Network performance analysis**
 - Semi-automatically annotated (n=200) data sets
 - Error quantification for landmarks & parameters
- **Parameter analysis & statistics on n=11000 data sets**
 - Automatic AVPD, AVPV, MVD, MAPSE, LS extraction
 - Parameter statistics (mean, std, histogram)
 - Visualisation of extreme cases

Results

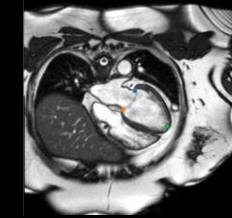
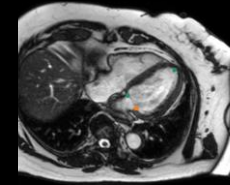
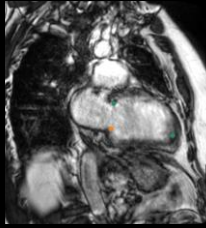
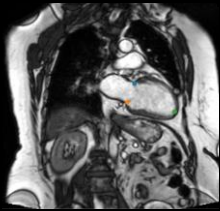
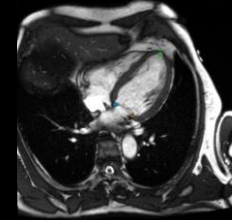
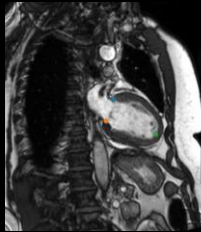
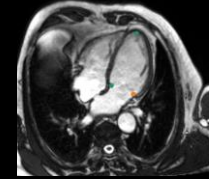
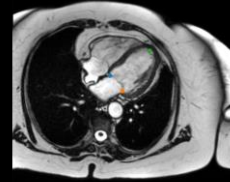


Results



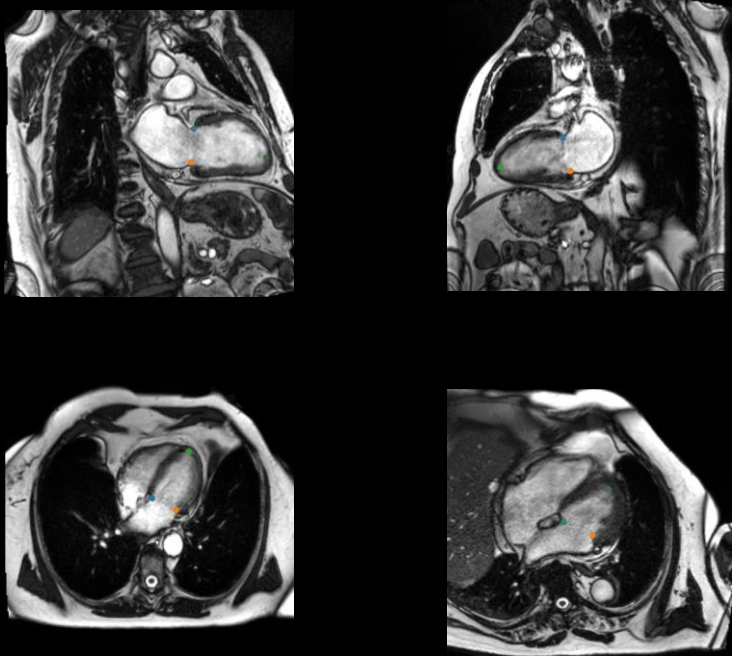
— = Two-chamber view
— = Four-chamber view

Results



Extreme MAPSE cases

Low



High



Conclusion & Outlook

- **Mean absolute distance errors ~ 2mm**
- **Successful on largely varying morphologies and image qualities**
- **Statistics on 11000 cardiac patient data sets**
- **Clear representation of expected MV motion parameters (velocity e & a waves)**
- **Self-supervised data mining – correlation with biometrics, clinical outcome, ...**
- **Evaluation of further landmarks (TAPSE, ...)**