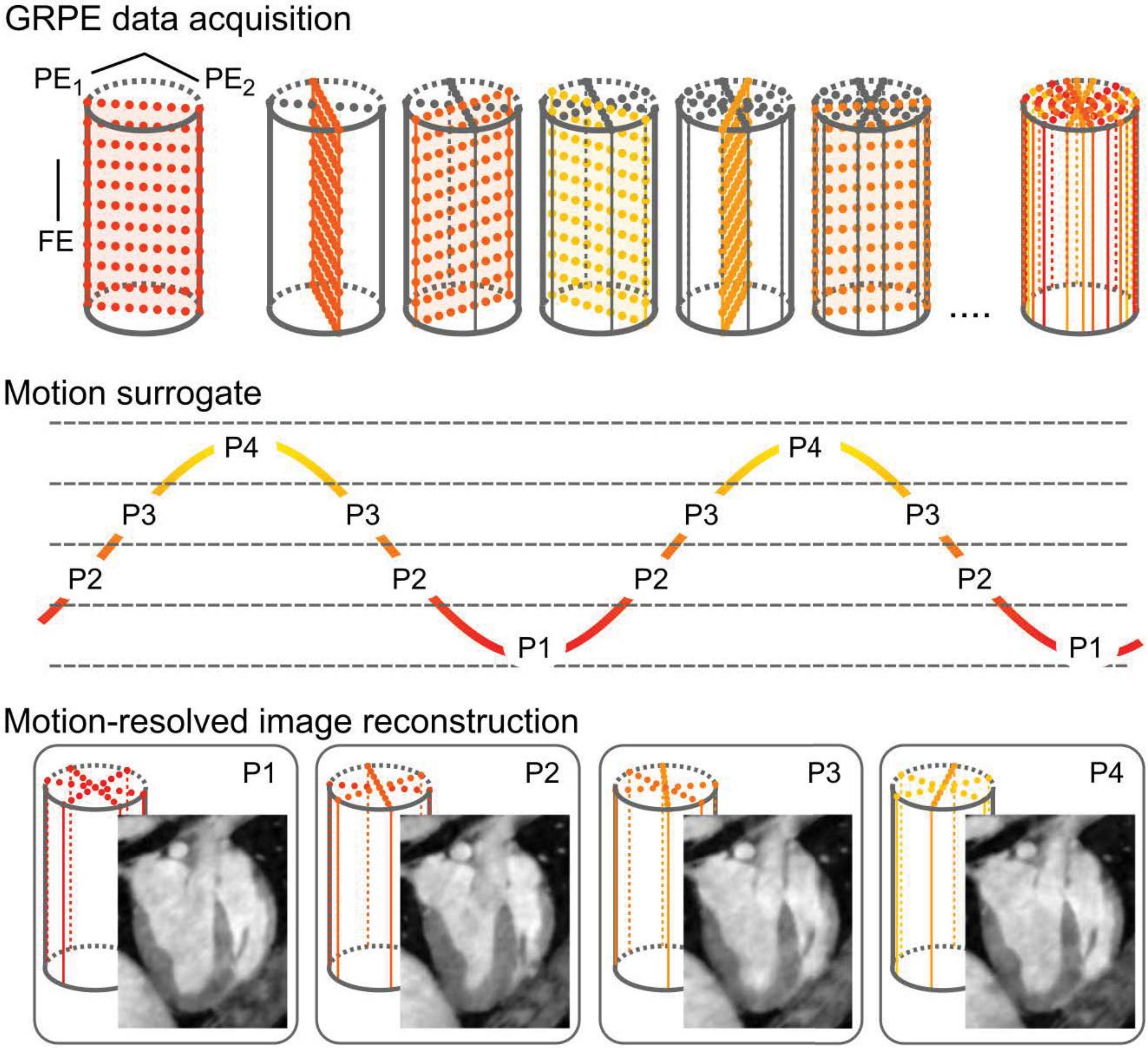
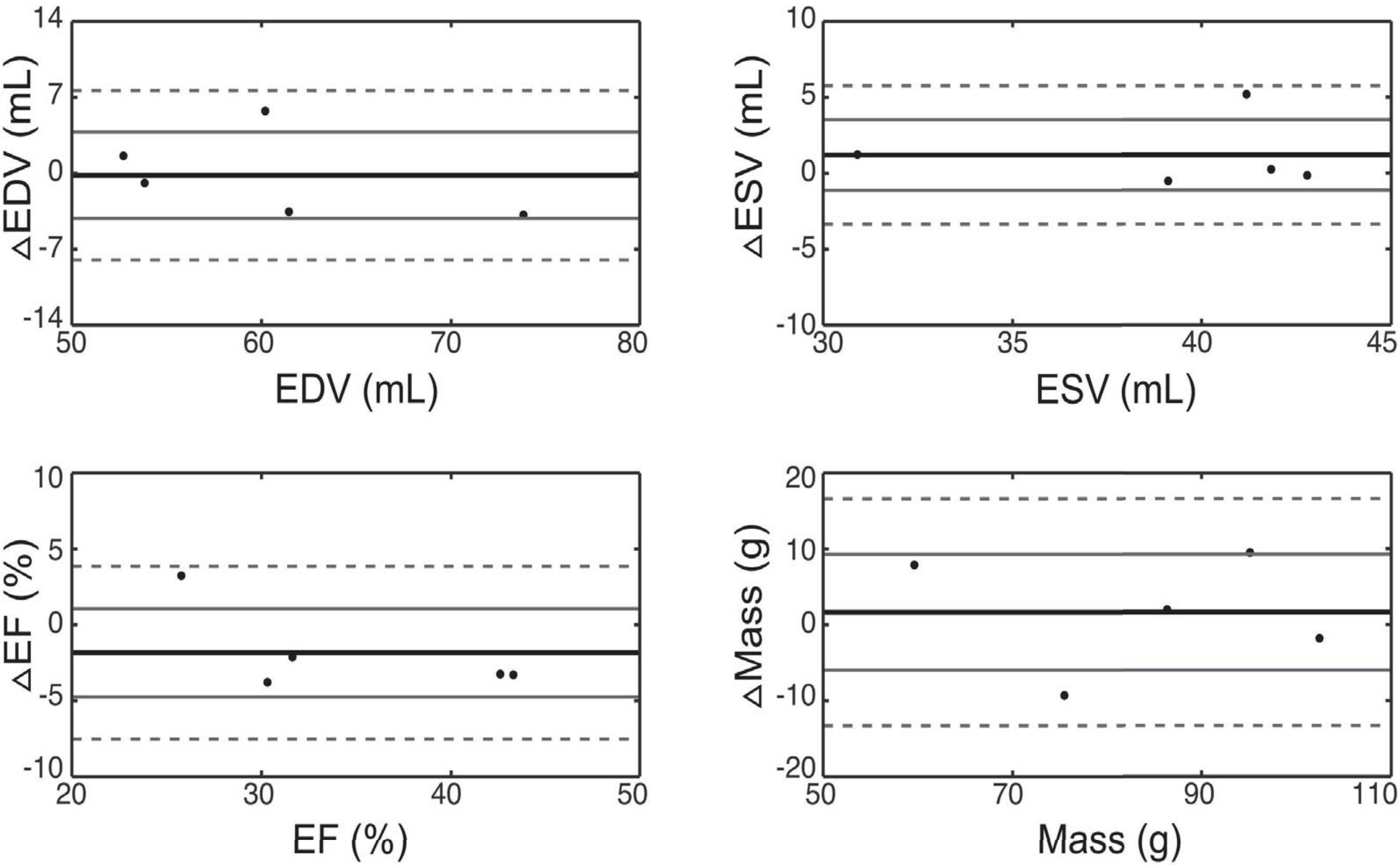
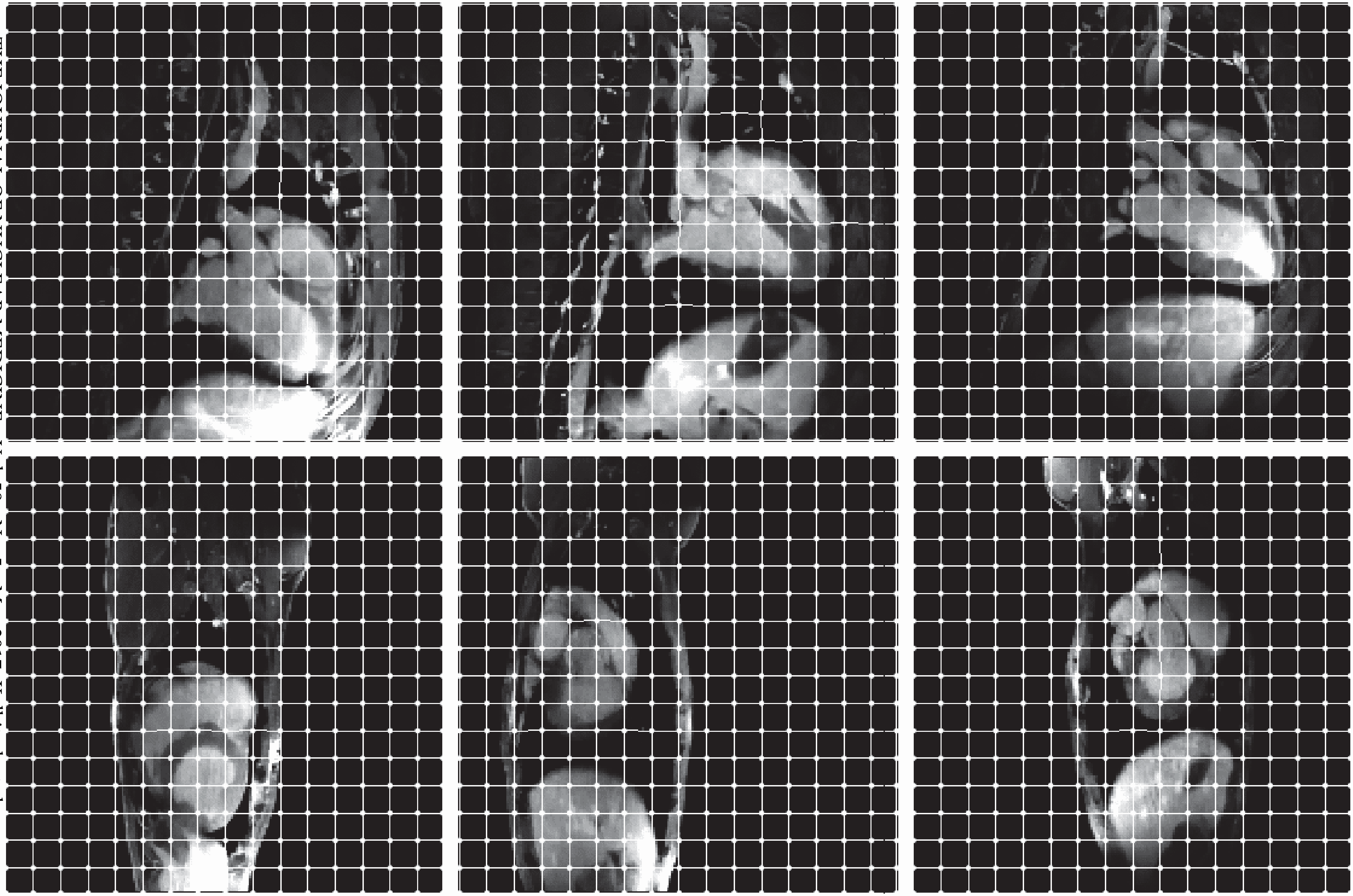


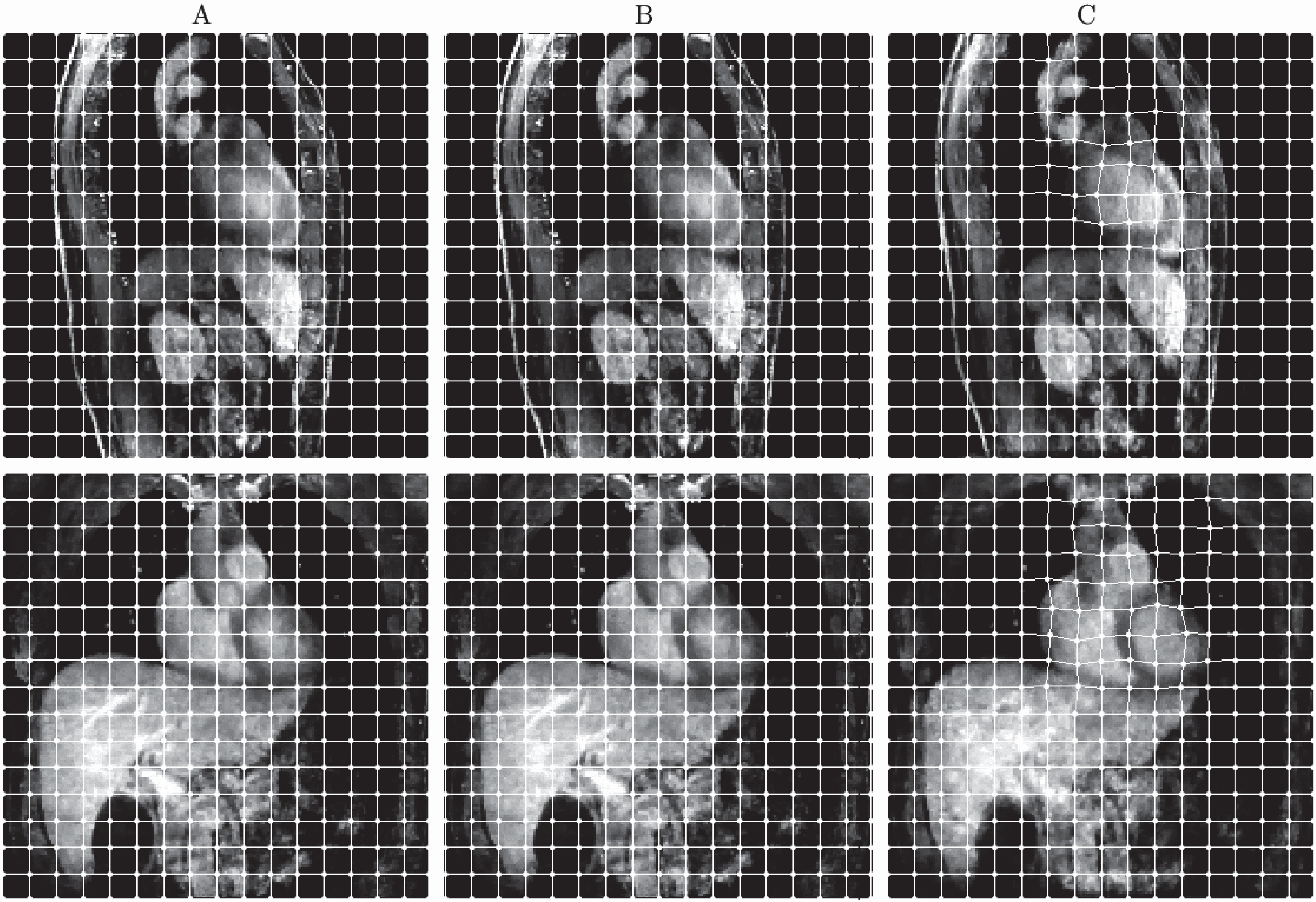
Supplemental Figure 1: Data acquisition with Golden Radial Phase Encoding (GRPE). GRPE is a 3D Cartesian sampling scheme with a Cartesian readout along the frequency encoding (FE) direction. The phase encoding points are located on radial lines in the 2D phase encoding plane (PE_1 – PE_2). The angle between subsequent lines is the golden angle leading to a homogeneous filling of the 2D PE_1 – PE_2 plane over time. Physiological signals (i.e. from external electrocardiogram) can be used to label the acquired data depending on their motion state (P1 – P4). Data acquired in the same motion state can be retrospectively binned yielding motion resolved 3D images. Due to the sampling properties of GRPE, the k-space data in each bin is homogenously distributed and a high image quality can be achieved using iterative image reconstruction schemes.



Supplemental Figure 2: Functional assessment. The functional assessment of the left ventricle shows excellent agreement between the Cartesian cine scan and the proposed method for end-diastolic volume (EDV), end-systolic volume (ESV), ejection fraction (EF) and myocardial mass (Mass).



Supplemental Figure 3: Overlay of motion grids deformed by estimated non-rigid cardiac motion fields on cardiac binned MR images for three different canine subjects. The motion grid follows the cardiac motion of the heart very well, suggesting accurate motion estimation. It is important to note that the motion grid is calculated in 3D but only a 2D intersection is shown which does not visualize motion perpendicular to the visualized image plane.



Supplemental Figure 4: Overlay of motion grids deformed by estimated motion fields on cardiac/respiratory binned MR images for a human subject. A: Affine respiratory motion fields, B: Non-rigid respiratory motion fields, C: Non-rigid cardiac motion fields.

Supplemental Table 1: Results of in-vivo PET acquisitions comparing the relative difference of full-width at half-maximum (ΔFWHM) at a mid-posterior (mid) and basal-posterior (bas) position in the left ventricle. The values were determined as the average over a 10° segment of the ventricle. All differences are given relative to the uncorrected case, except for ΔFWHM(MCIR – $CG_{20\%}$) and ΔFWHM(MCIR – $CG_{60\%}$) where the difference is relative to $CG_{20\%}$ and $CG_{60\%}$, respectively. A paired student t-test was used to determine statistical significance ($p < 0.01$, results marked in bold). UNC: Uncorrected, $CG_{20\%}$: cardiac gating window in mid-diastole including 20% of the total data, $CG_{60\%}$: cardiac gating window in mid-diastole including 60% of the total data, MCIR: cardiac motion compensation, Mean/Std: average and standard deviation over all subjects and locations.

		ΔFWHM				
		$CG_{20\%}$ - UNC	$CG_{60\%}$ - UNC	MCIR - UNC	MCIR – $CG_{20\%}$	MCIR – $CG_{60\%}$
Subject 1	bas	-13.30%	3.99%	-9.12%	4.82%	-12.60%
	mid	-9.08%	-2.56%	-9.78%	-0.77%	-7.40%
Subject 2	bas	-28.96%	-15.37%	-23.61%	7.54%	-9.73%
	mid	-15.26%	-7.52%	-14.89%	0.44%	-7.97%
Subject 3	bas	-11.09%	-3.57%	-11.85%	-0.85%	-8.58%
	mid	-11.16%	-3.80%	-8.37%	3.14%	-4.75%
Subject 4	bas	-29.26%	-8.41%	-19.39%	13.96%	-11.98%
	mid	-11.45%	-4.53%	-12.74%	-1.45%	-8.59%
Subject 5	bas	-5.86%	-1.08%	-11.34%	-5.82%	-10.37%
	mid	-0.43%	-0.43%	-10.34%	-9.95%	-9.95%
Mean		**-13.59%**	-4.33%	**-13.14%**	1.11%	**-9.19%**
Std		**9.16%**	5.25%	**4.89%**	6.74%	**2.28%**
p-value		**<0.001**	0.014	**<0.001**	0.5	**<0.001**

Supplemental Table 2: Results of in-vivo PET acquisitions comparing the relative difference of contrast to noise ratio (ΔCNR) at a mid-posterior (mid) and basal-posterior (bas) position in the left ventricle. The values were determined as the average over a 10° segment of the ventricle. All differences are given relative to the uncorrected case, except for ΔCNR(MCIR – $CG_{20\%}$) and ΔCNR(MCIR – $CG_{60\%}$) where the difference is relative to $CG_{20\%}$ and $CG_{60\%}$, respectively. A paired student t-test was used to determine statistical significance ($p < 0.01$, results marked in bold). UNC: Uncorrected, $CG_{20\%}$: cardiac gating window in mid-diastole including 20% of the total data, $CG_{60\%}$: cardiac gating window in mid-diastole including 60% of the total data, MCIR: cardiac motion compensation, Mean/Std: average and standard deviation over all subjects and locations.

		ΔCNR				
		$CG_{20\%}$ - UNC	$CG_{60\%}$ - UNC	MCIR - UNC	MCIR – $CG_{20\%}$	MCIR – $CG_{60\%}$
Subject 1	bas	-20.02%	-16.00%	6.99%	25.61%	27.99%
	mid	-60.46%	-14.81%	-19.36%	111.91%	-1.65%
Subject 2	bas	139.76%	57.26%	71.27%	45.16%	121.31%
	mid	24.49%	18.91%	42.77%	40.36%	46.94%
Subject 3	bas	2.93%	-18.18%	27.56%	34.12%	68.73%
	mid	-13.62%	-1.30%	36.31%	81.76%	59.07%
Subject 4	bas	-57.98%	-25.44%	19.39%	195.25%	66.40%
	mid	-38.88%	-30.41%	7.95%	77.73%	56.10%
Subject 5	bas	-46.36%	-16.80%	26.37%	153.17%	63.22%
	mid	-66.15%	-37.00%	-28.99%	129.05%	23.07%
Mean		-13.63%	-8.38%	19.03%	**89.41%**	**53.12%**
Std		61.40%	27.82%	29.37%	**56.79%**	**32.98%**
p-value		0.07	0.08	0.12	**0.005**	**0.0012**