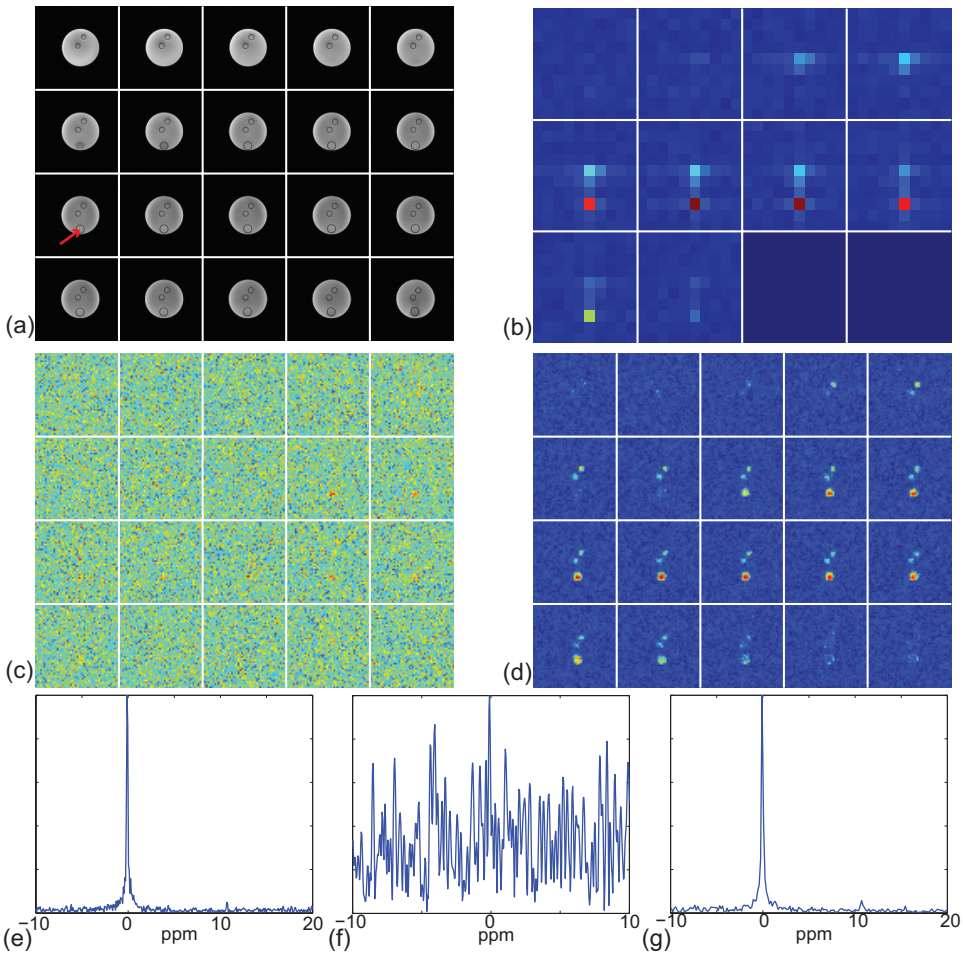
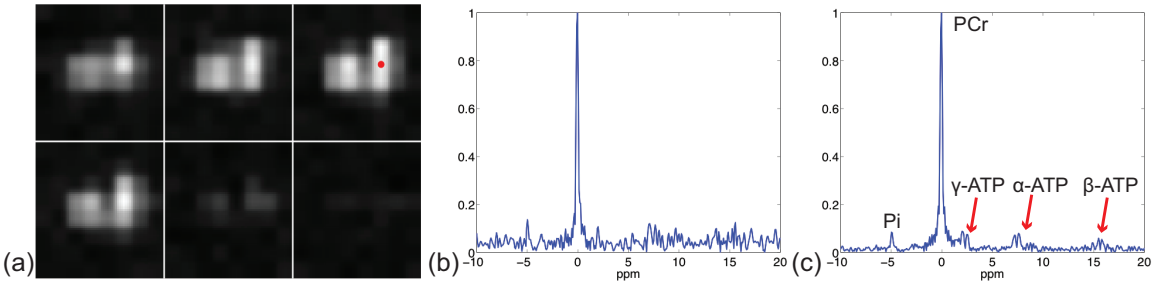
Supporting Information

Supporting Table S1: Reconstruction dimension and model order

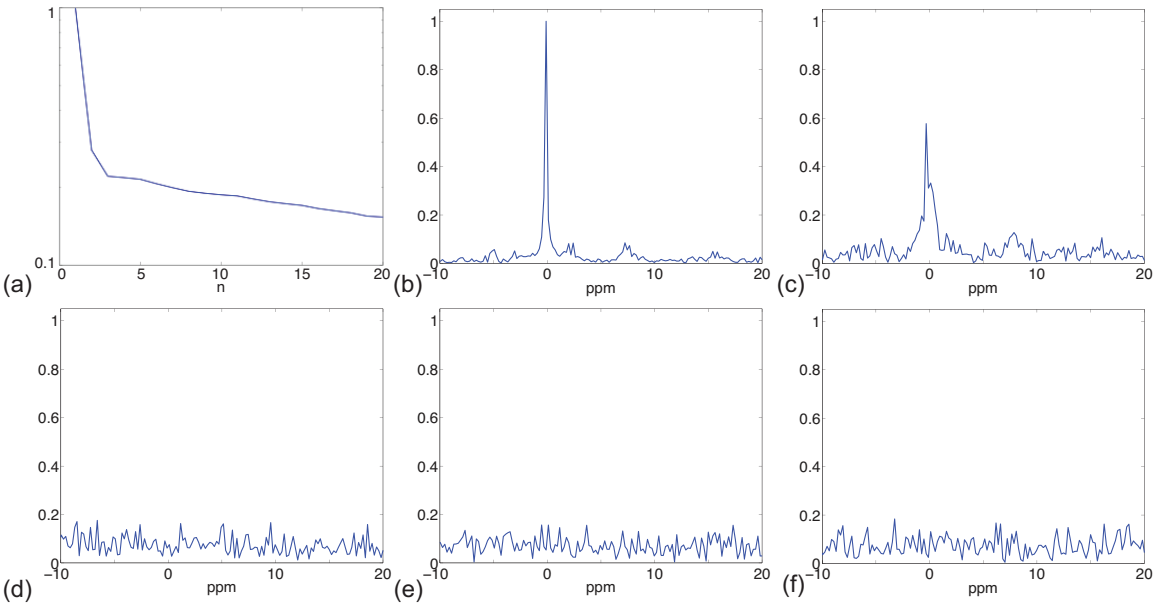
Experiment	P	Q	R	L	M	N
Phantom	50×50×20	192	1	5	5	1
Human: Static	32×32×12	192	1	5	5	1
Human: Dynamic (before exercise)	32×32×12	192	12	10	5	2
Human: Dynamic (after exercise)	32×32×12	192	12	15	5	4
Animal: Dynamic	32×32×12	256	30	6	5	4



Supporting Figure S1: Static ^{31}P-MRSI on a phantom. (a) ^{1}H structural images. (b) to (d) Maps of Pi obtained by the conventional CSI ($10\times10\times10$ spatial encodings and 6 averages), EPSI ($50\times50\times20$ spatial encodings and 6 averages), and the proposed method ($50\times50\times20$ spatial encodings), respectively, in an equivalent-time acquisition experiment. (e) to (g) Representative spectra from (b) to (d). The location of the spectrum isindicated by the red arrow in (a).



Supporting Figure S2: Static ^{31}P-MRSI of the calf muscle by a low-resolution CSI acquisition ($10\times10\times6$ spatial encodings). (a) Map of PCr. (b) and (c) Representative spectra before and after LORA (Nguyen et al., IEEE Trans Biomed Eng, 2013;60:78-89) denoising.



Supporting Figure S3: Singular value distribution (a) and the cooresponding spectral basis functions that were used to generate Fig.3.