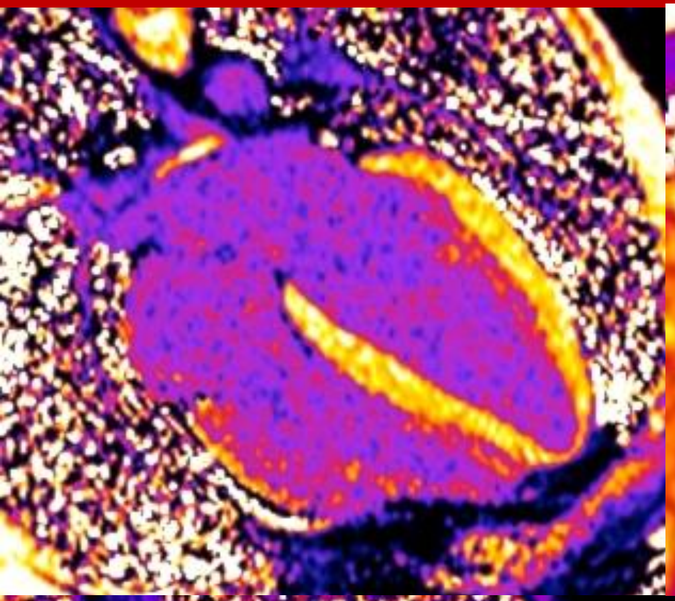
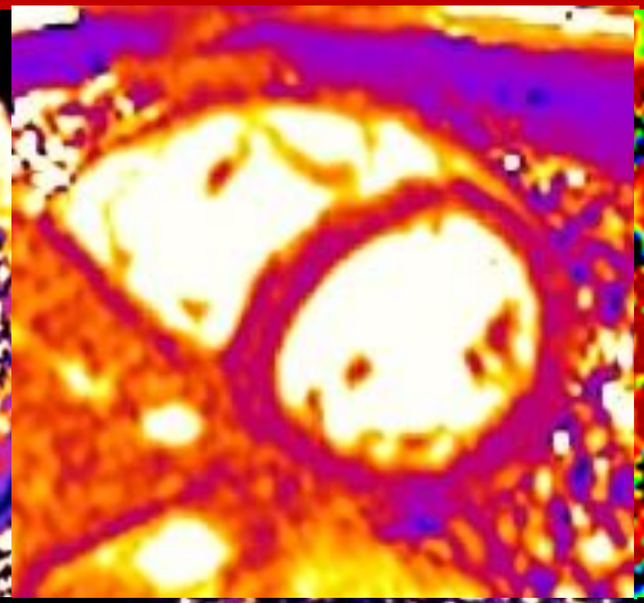
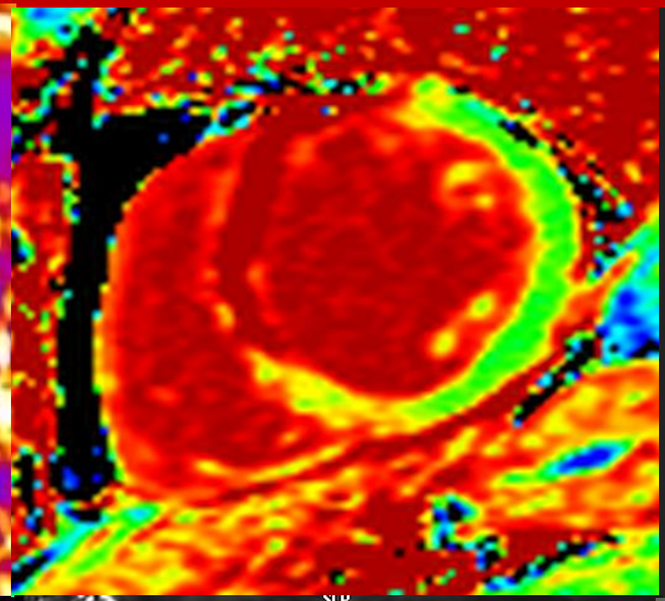
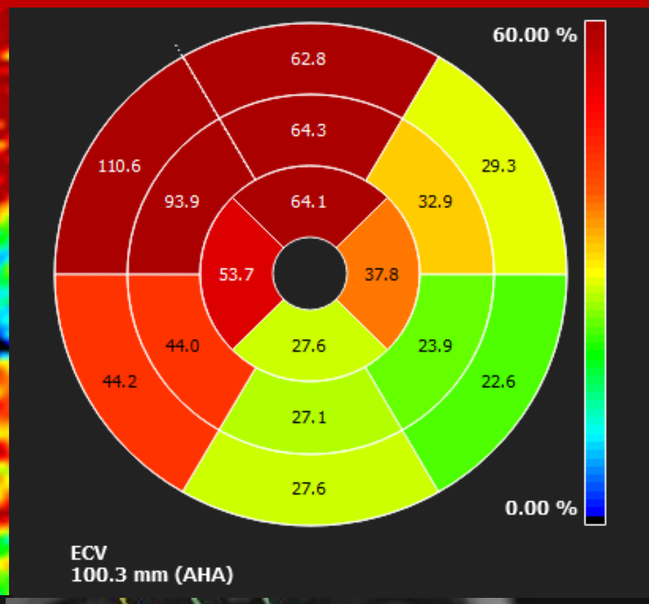
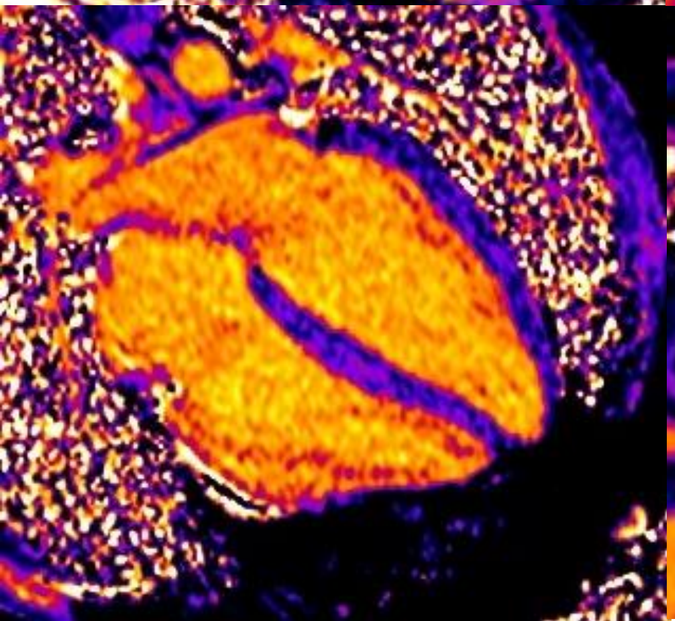
Mapping Parametrico Cardiaco: tecniche di acquisizione e ottimizzazione

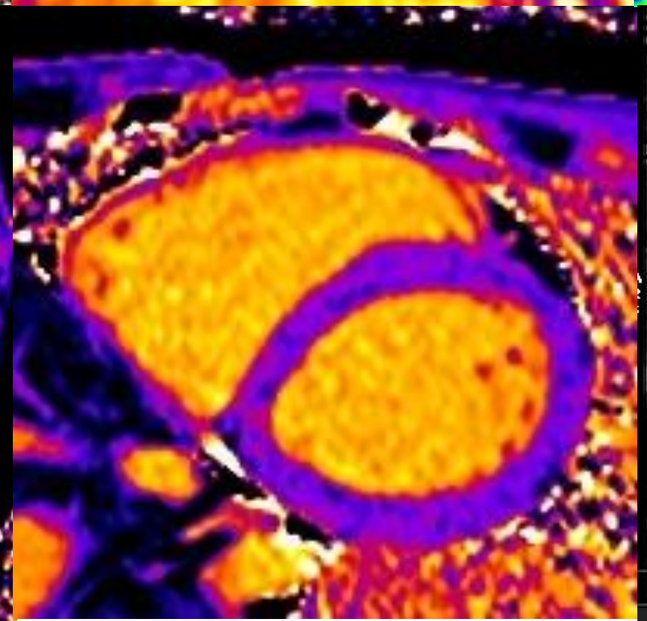


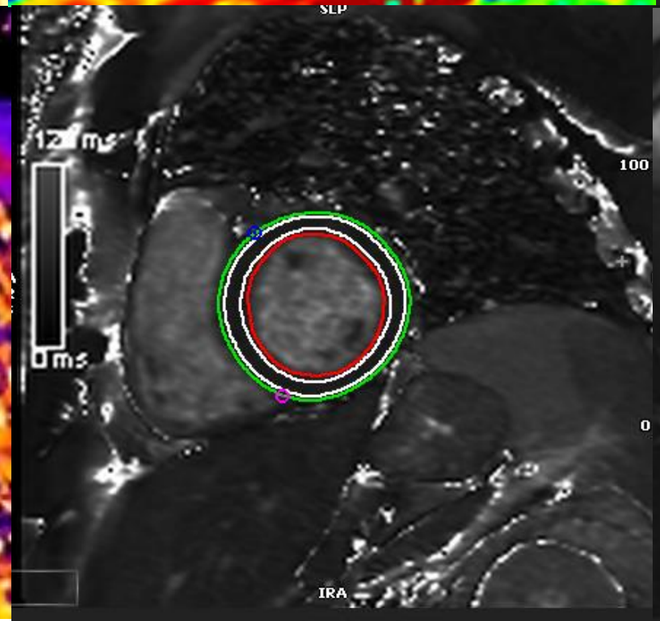


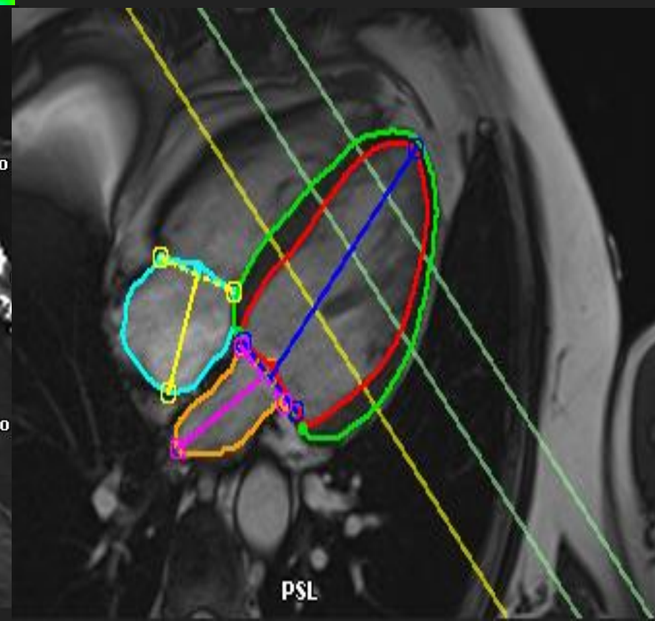




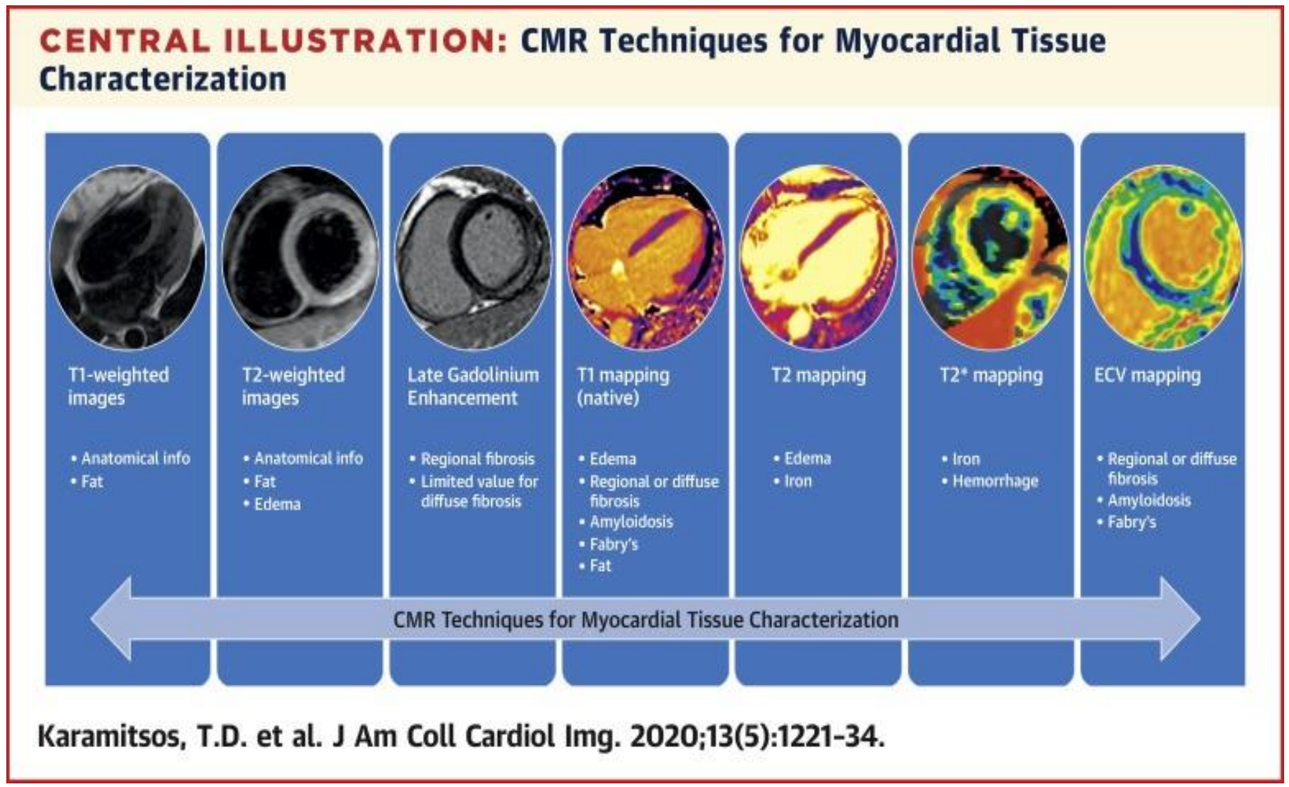


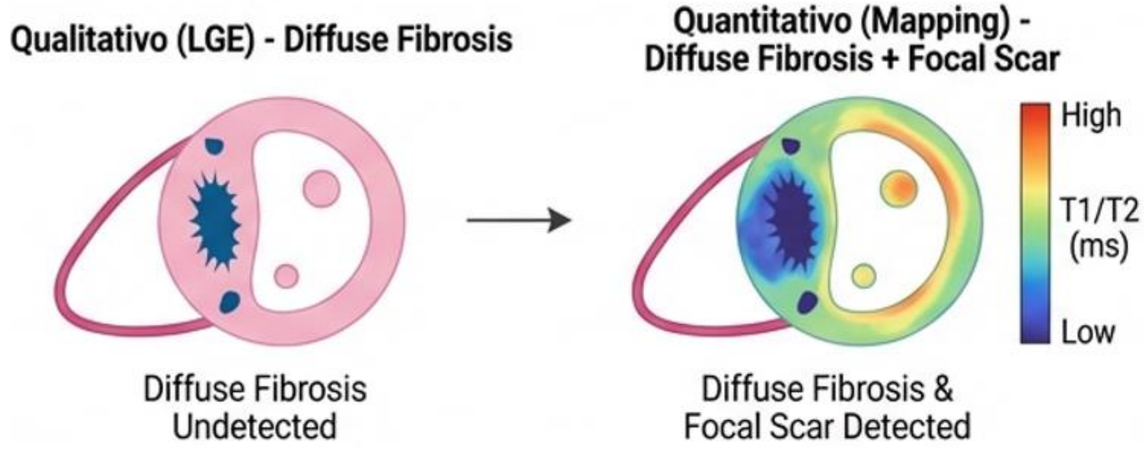






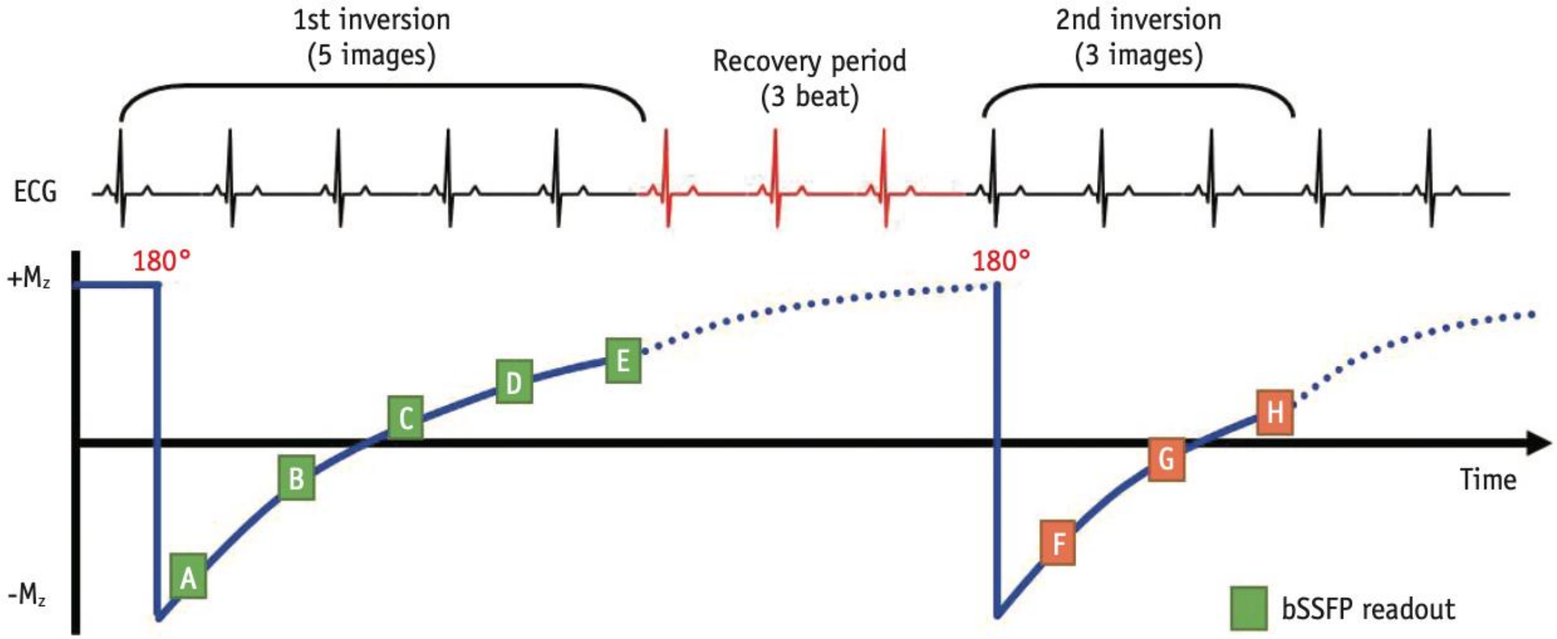
CMR mapping: la quarta era dell'imaging cardiaco

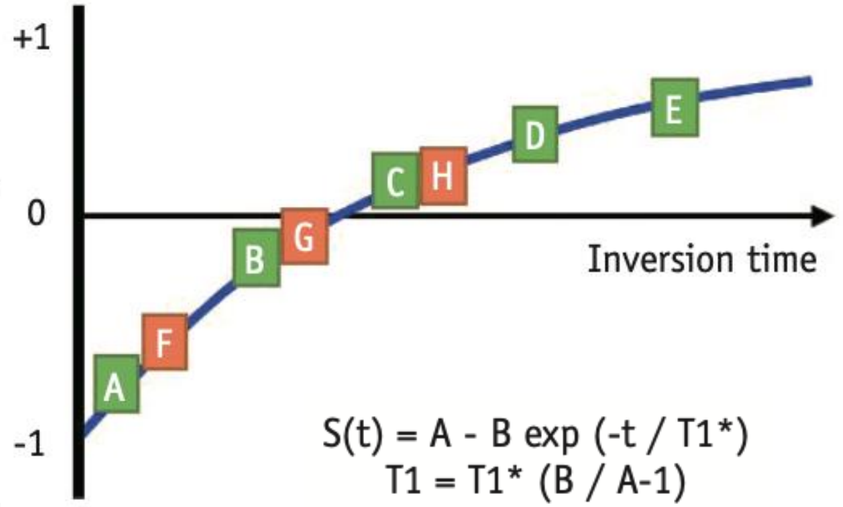


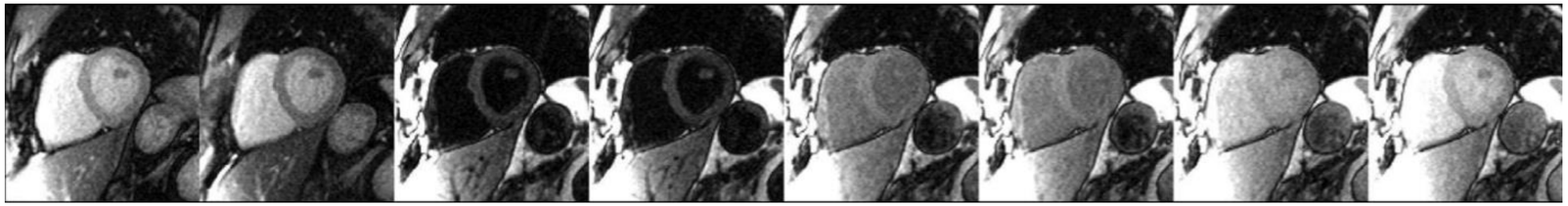


T1 mapping: Modified Look–Locker inversion recovery (MOLLI)

Schema di acquisizione: 5(3)3 oppure 5s(3s)3s (minor sensibilità alla fequenza cardiaca)



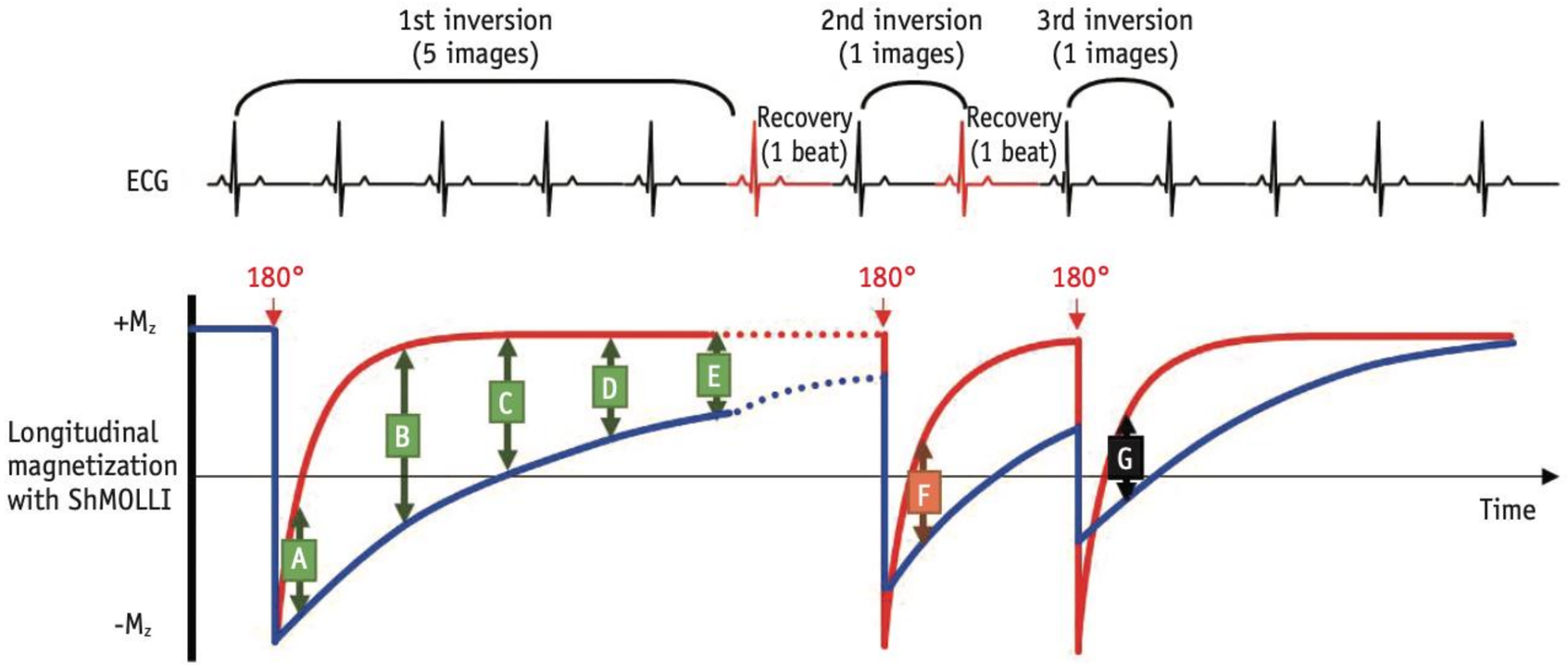


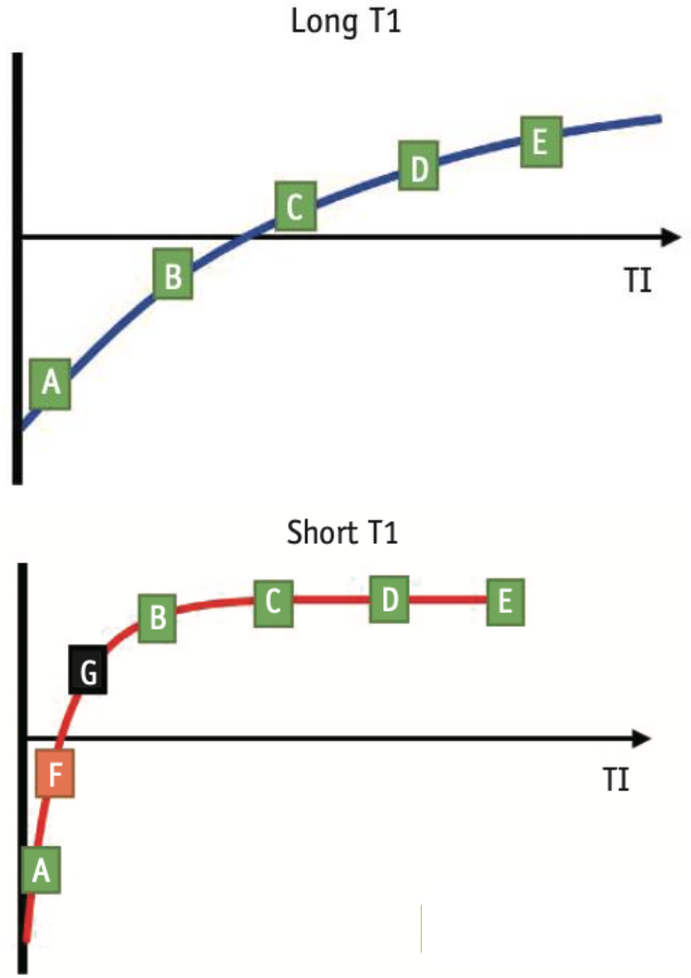


Pan Ki Kim et al.

T1 mapping: Shortened modified Look–Locker inversion recovery (ShMOLLI)

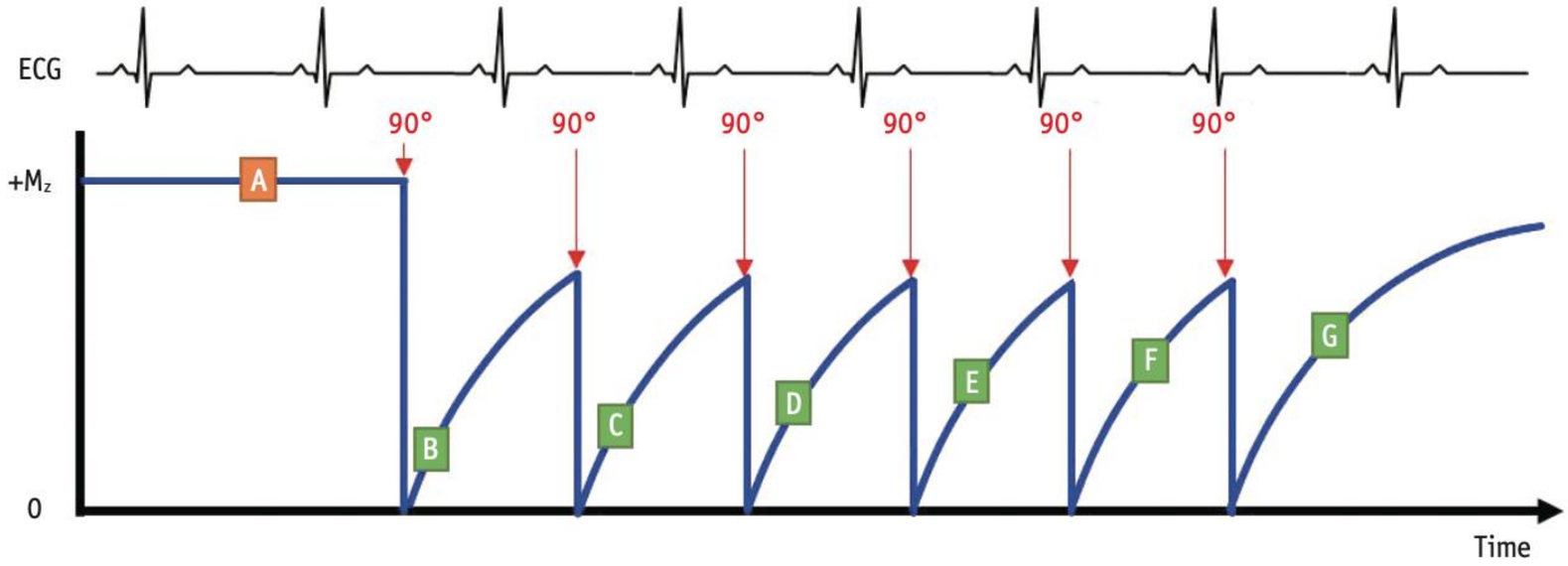
Schema di acquisizione: 5(1)1(1)1

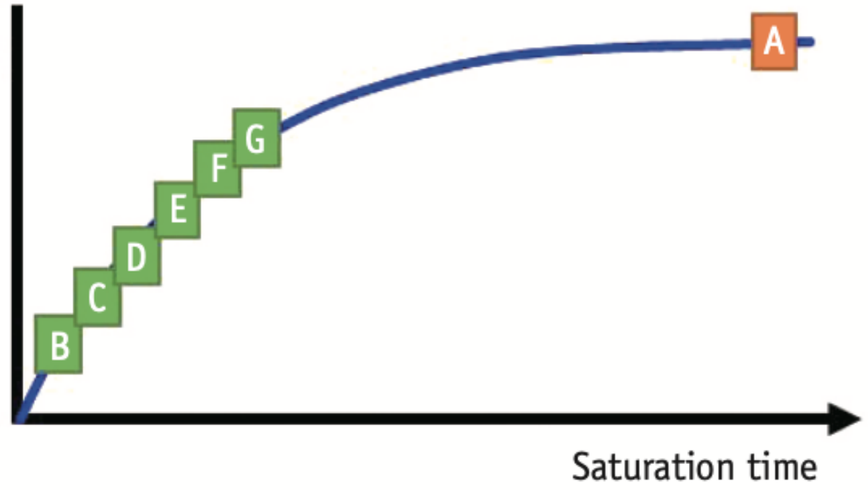




Pan Ki Kim et al.

T1 mapping: Saturation recovery single-shot (SASHA)





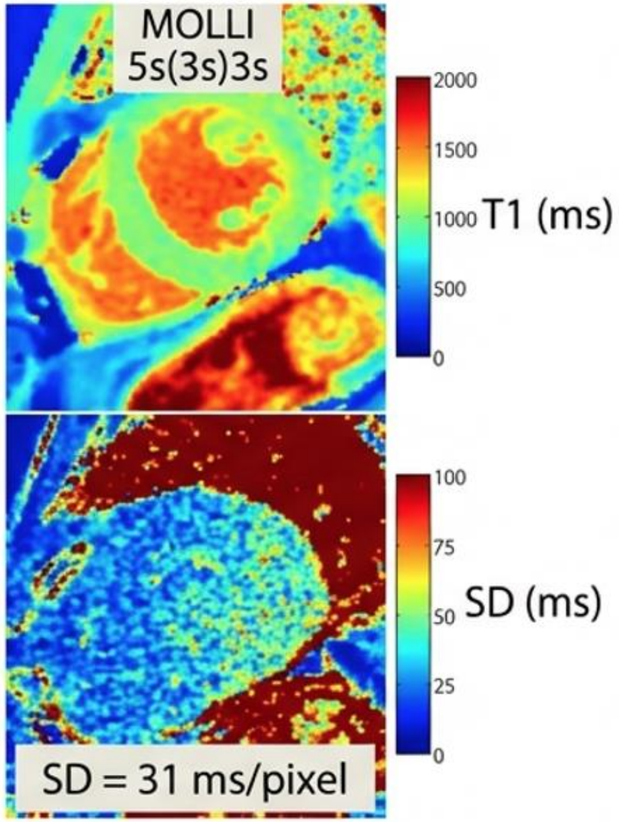
2-parameter fitting model
$S(t) = A\ (1 - \exp\ [-t / T1])$

3-parameter fitting model
$S(t) = A - B \exp\ (-t / T1)$

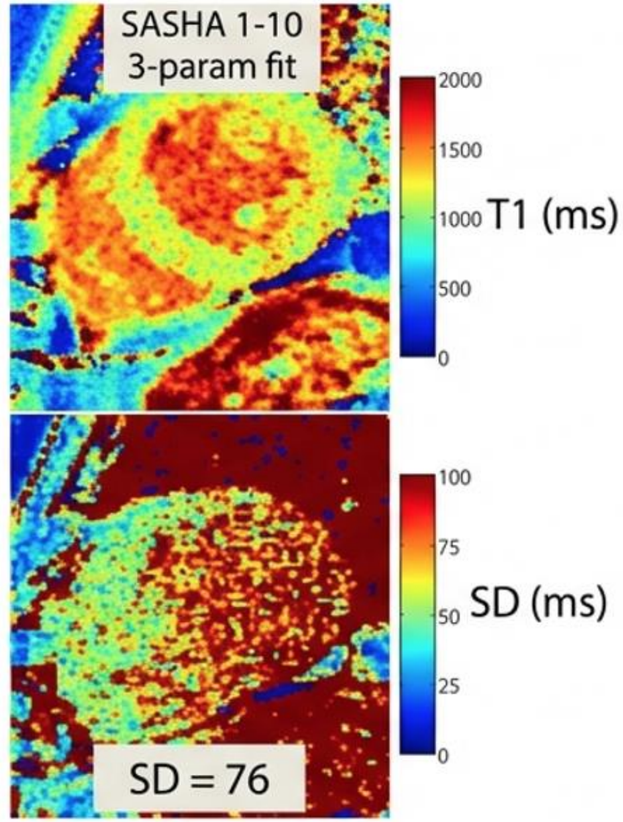
Pan Ki Kim et al.

MOLLI vs. SASHA: accuratezza vs. precisione

MOLLI: Alta Precisione (SNR elevato), ma minore Accuratezza (sottostima T1).

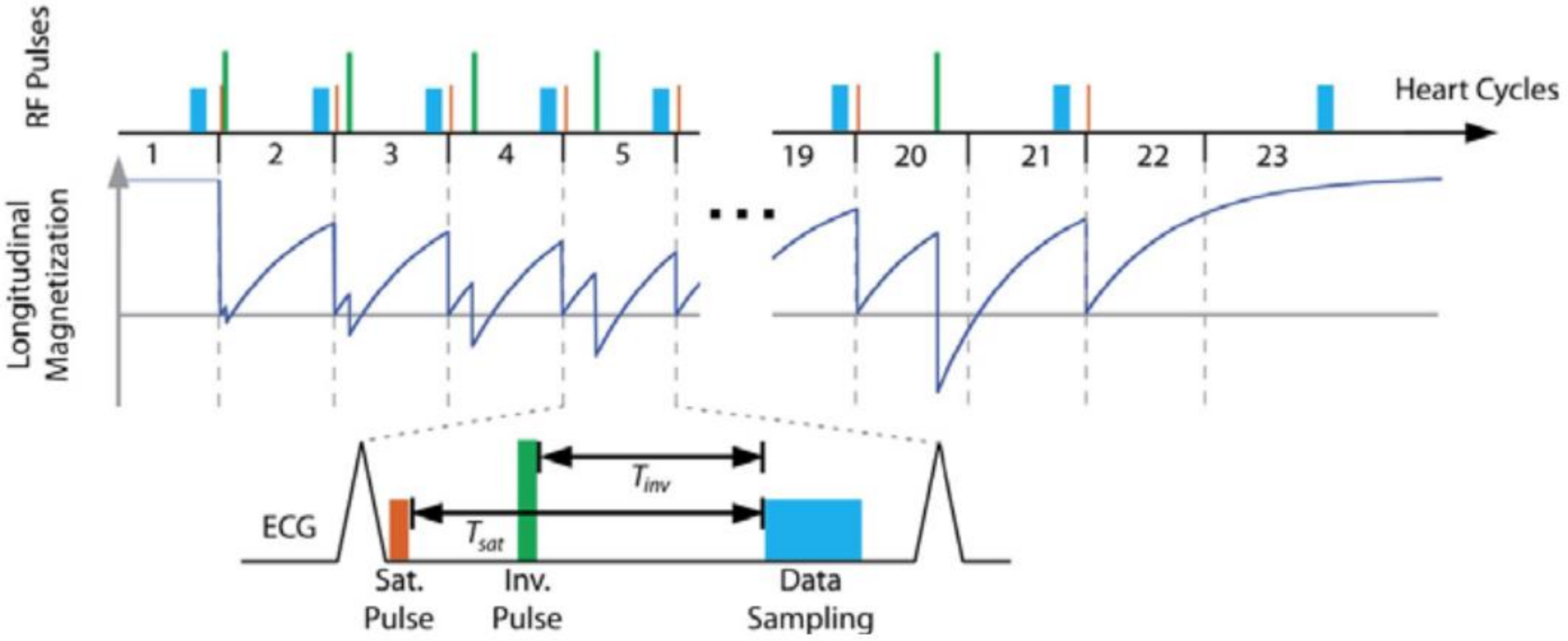


SASHA: Alta Accuratezza (valori reali), ma **bassa** Precisione (rumore).



Peter Kellman and Michael S Hansen

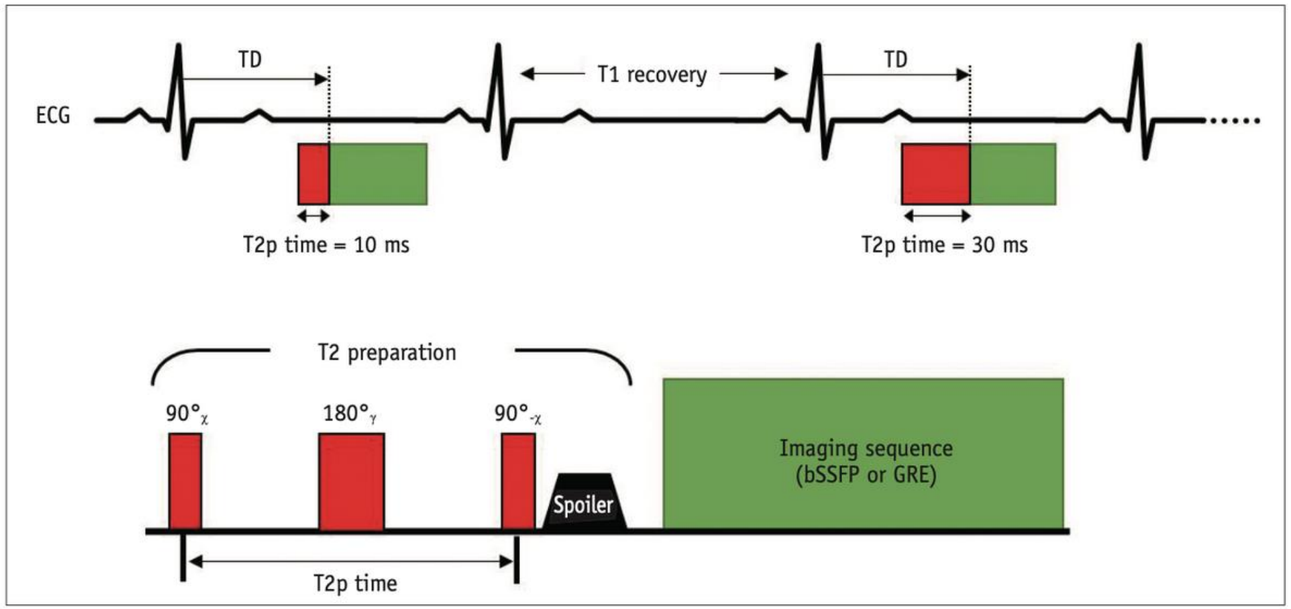
SAturation Pulse Prepared Heart rate independent Inversion-REcovery - SHAPPIRE



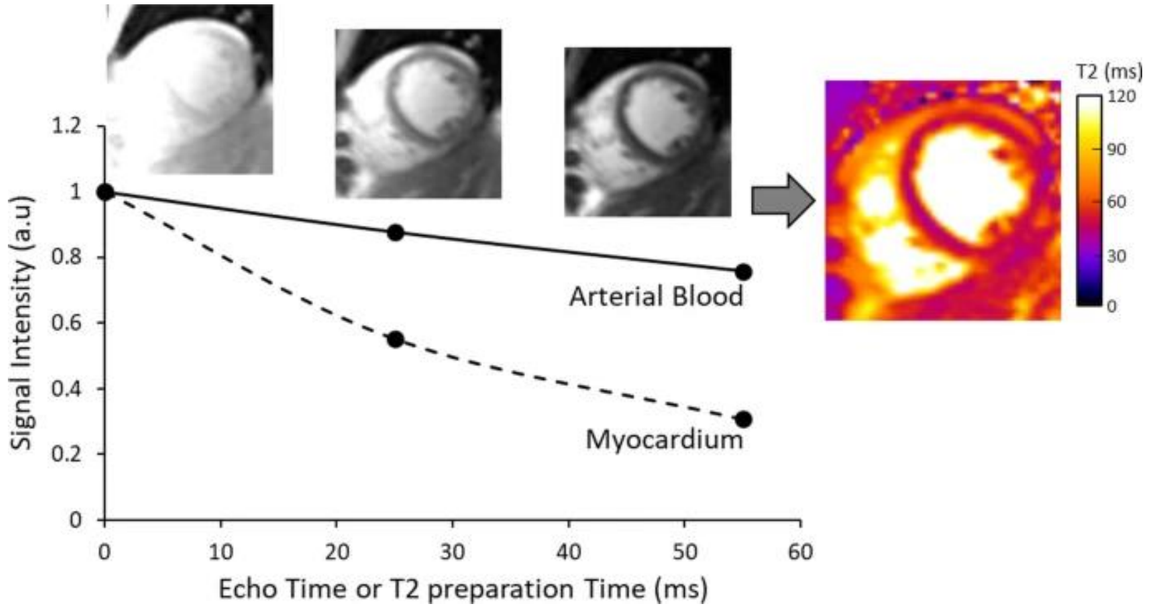
Sebastian Weingärtner et al.

T2 mapping

$$S(t) = A \exp(-t / T2)$$

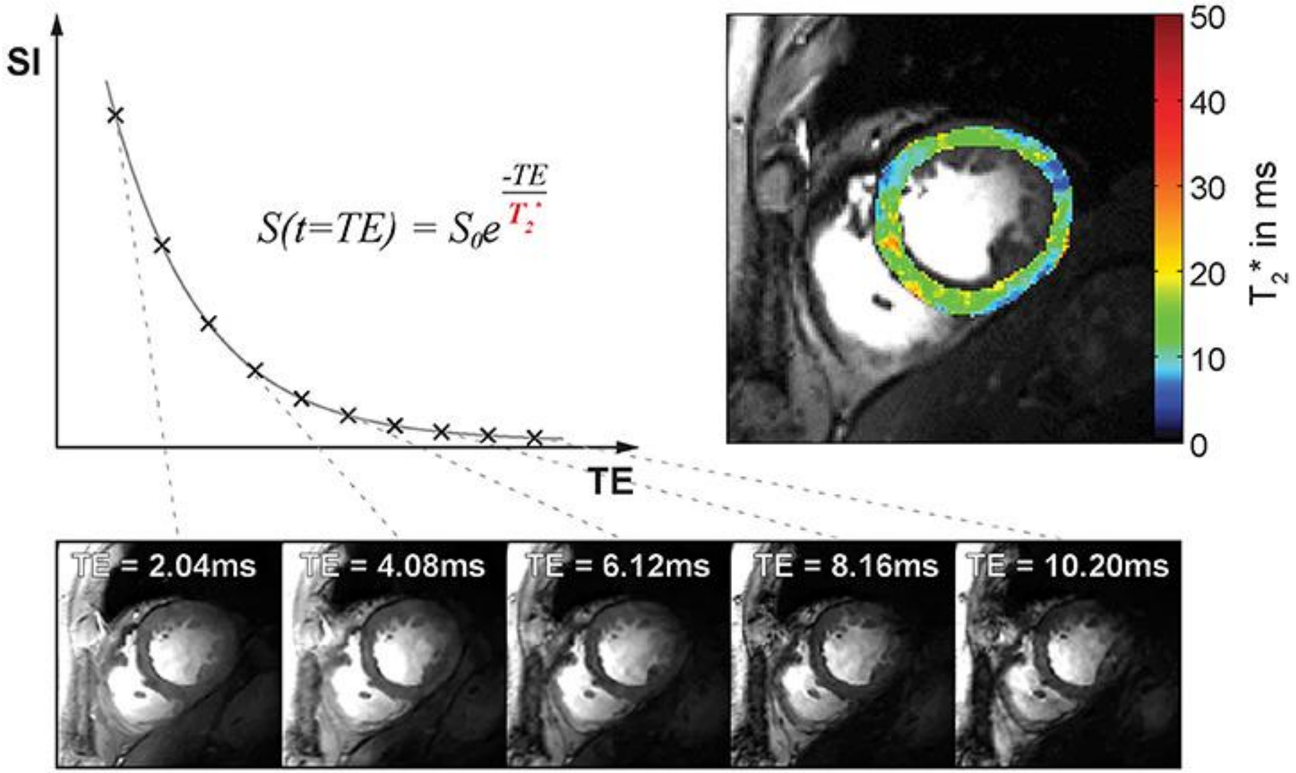


Pan Ki Kim et al.

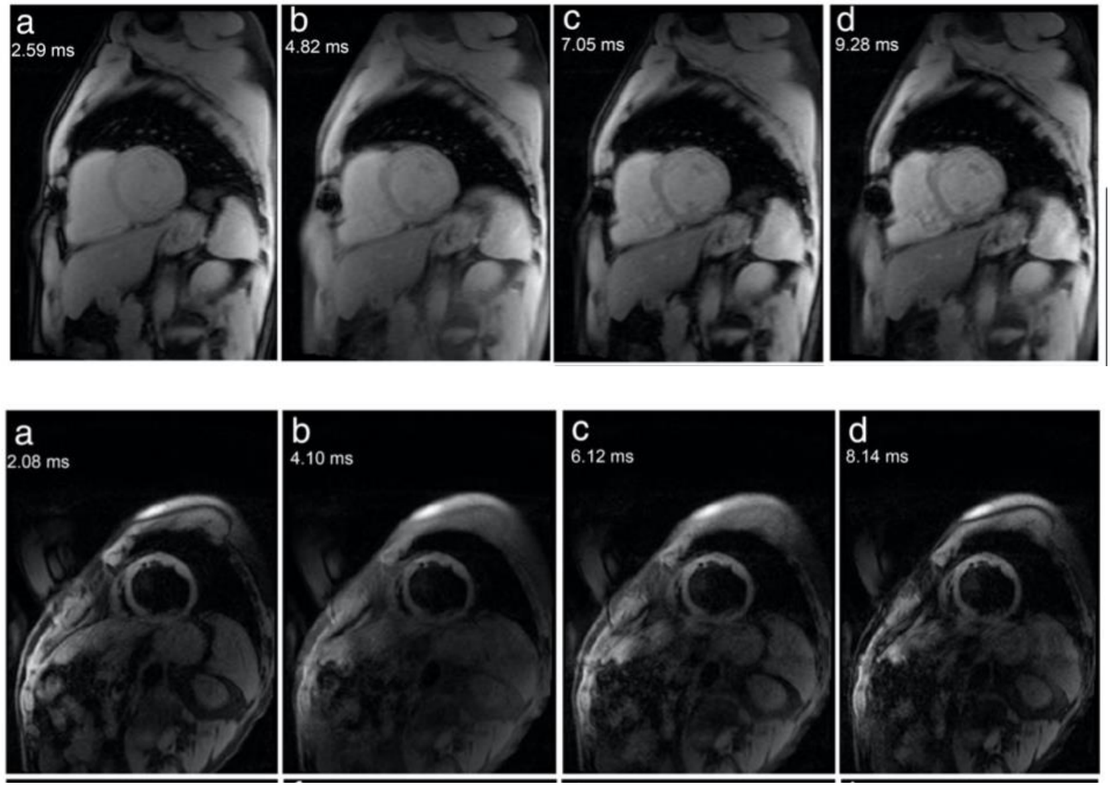


O'Brien et al

T2* mapping

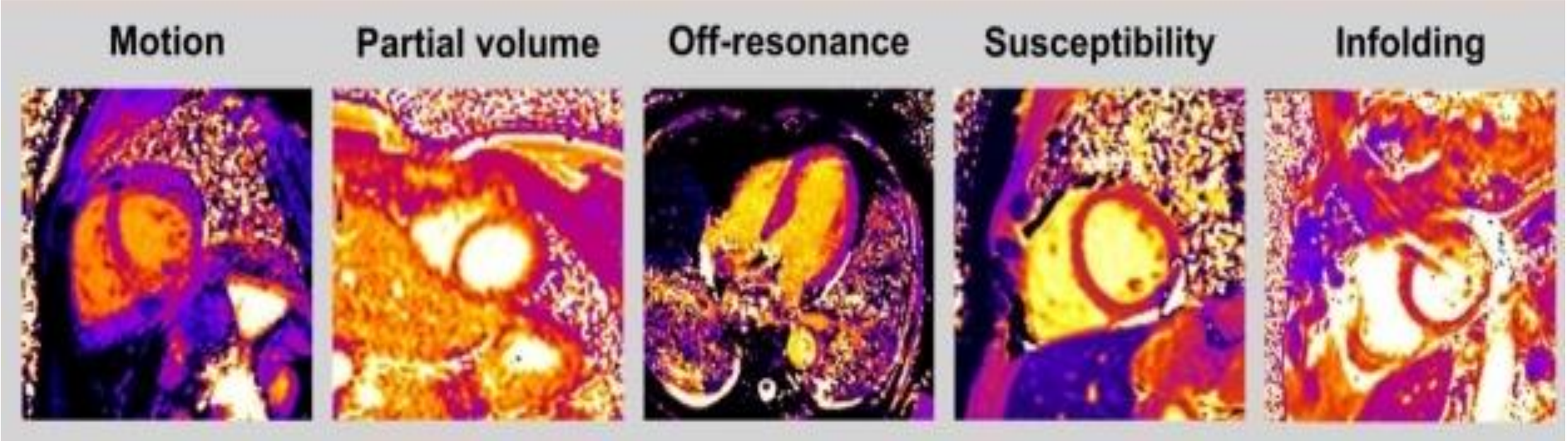


Till Huelnhagen et all



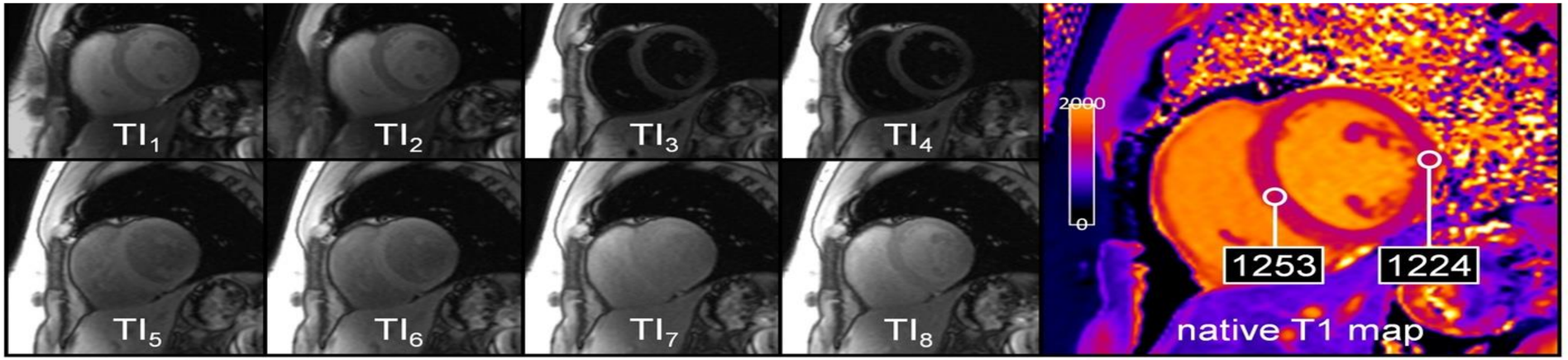
Pandji Triadyaksa et al

Gestione degli artefatti

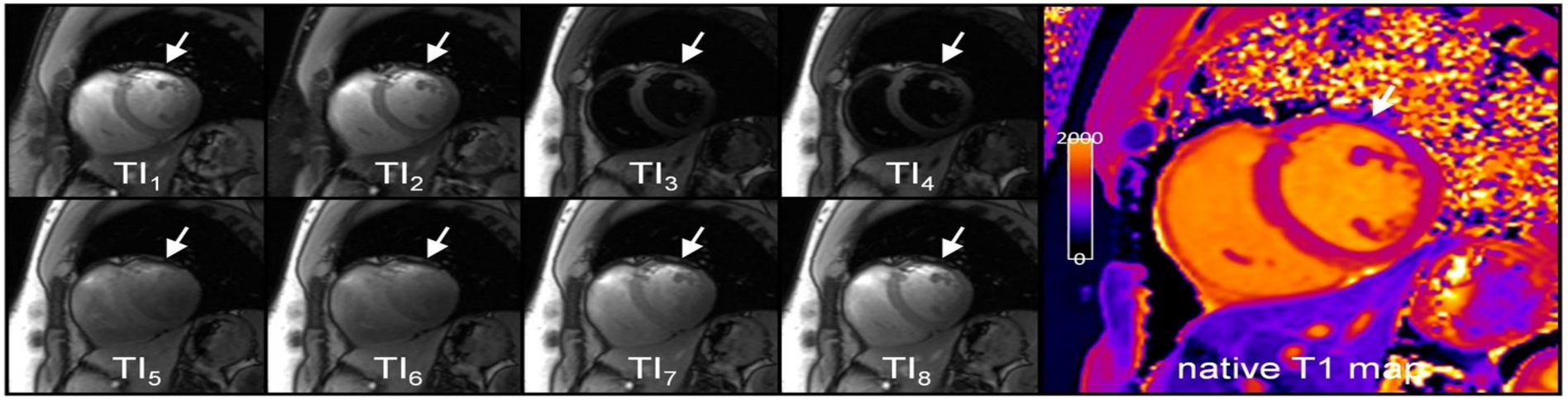


Fenski et al.

Gestione degli artefatti: off-resonance



scanner center-frequency offset = -30 Hz

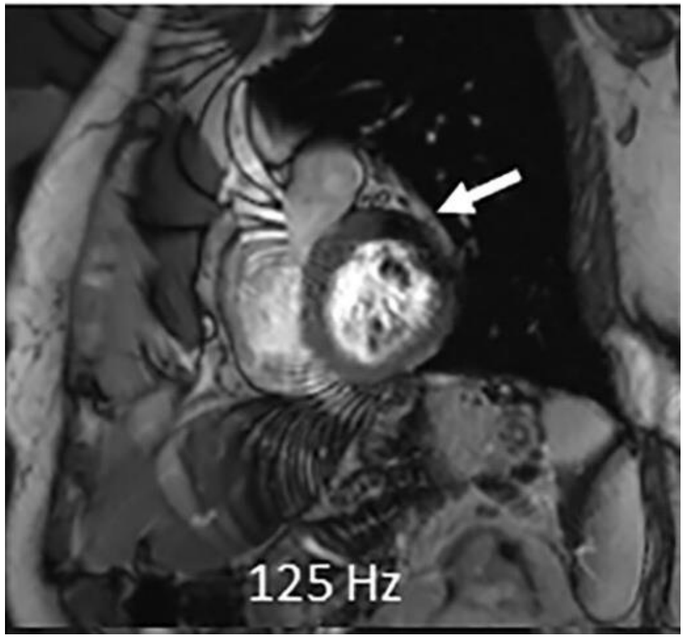


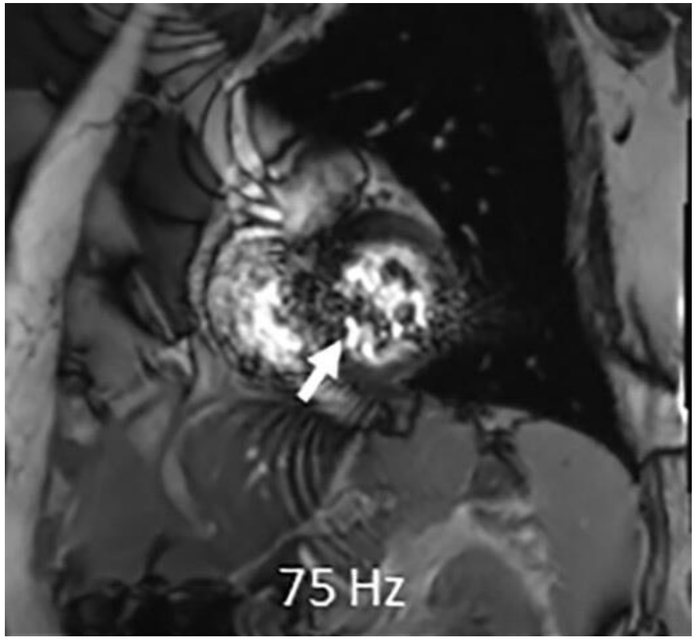
scanner center-frequency offset = -120 Hz

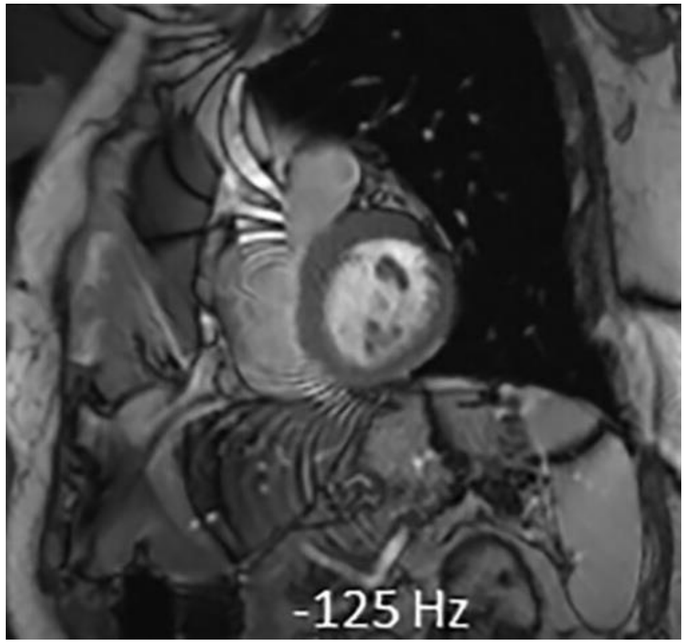
Gert Reiter et al.

Gestione degli artefatti: off-resonance

È possibile utilizzare un ***Frequency Scout*** per identificare la frequenza centrale e spostare gli artefatti fuori dal cuore

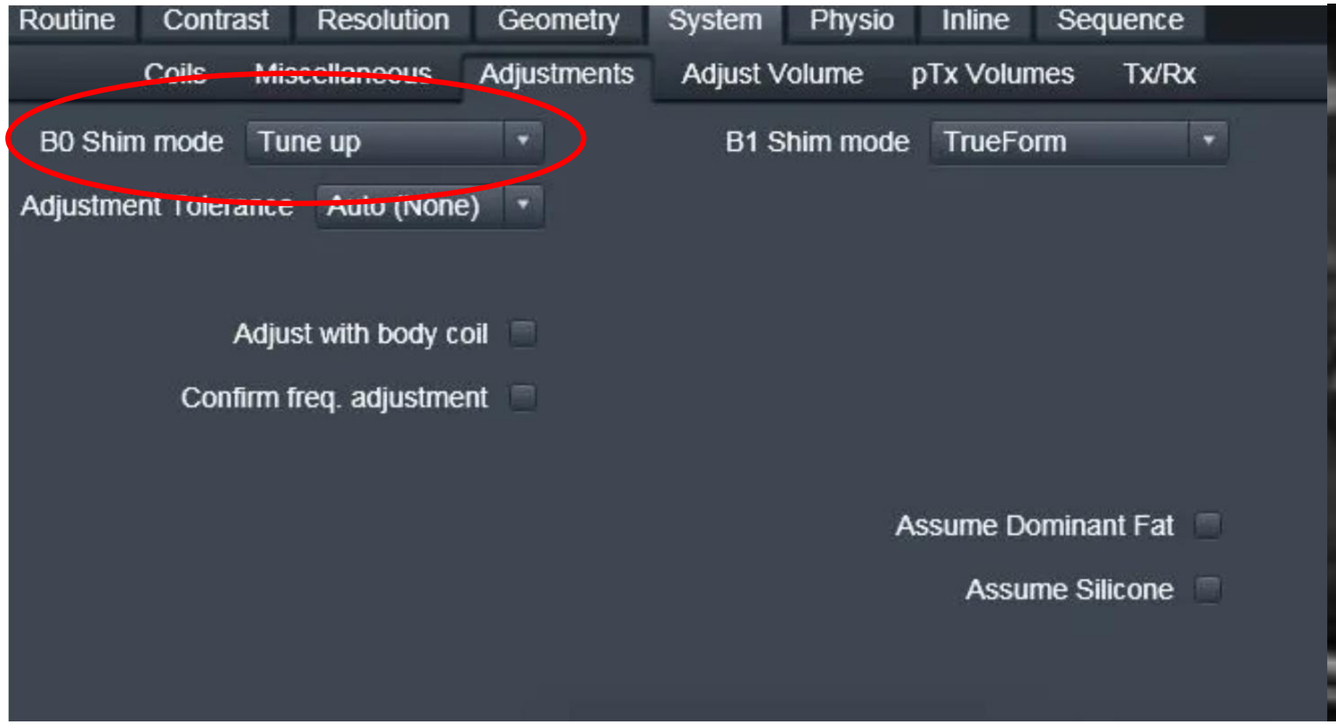


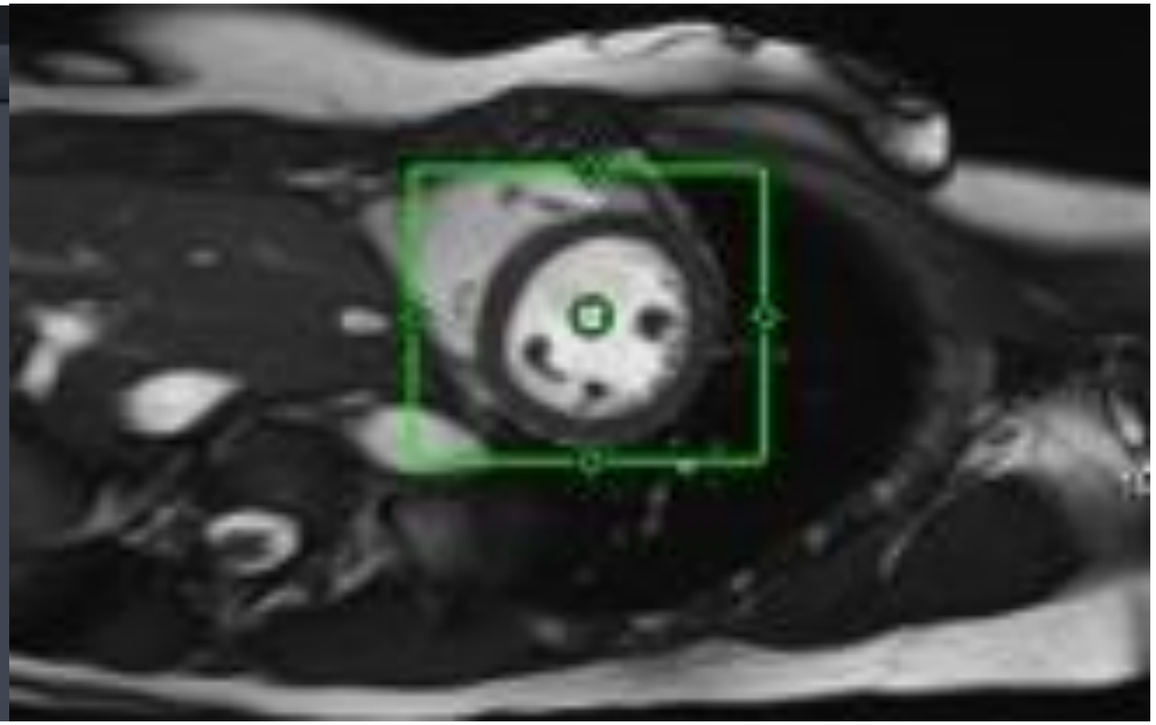




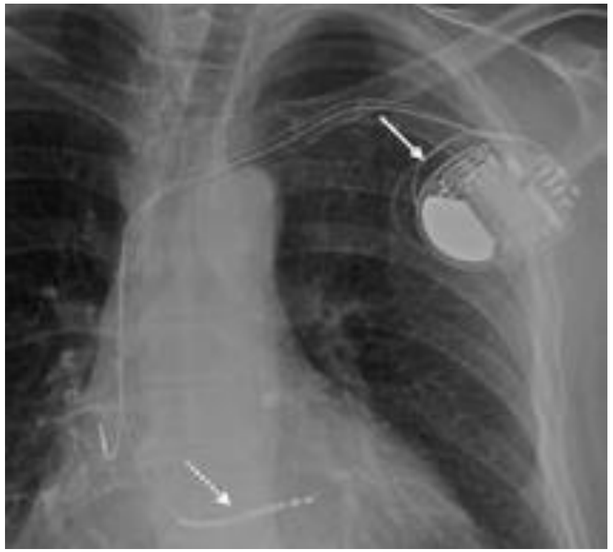
Regolazione dell'offset di frequenza: **(Siemens)** Trufi Delta Frequency **(GE)**: Manual shimming

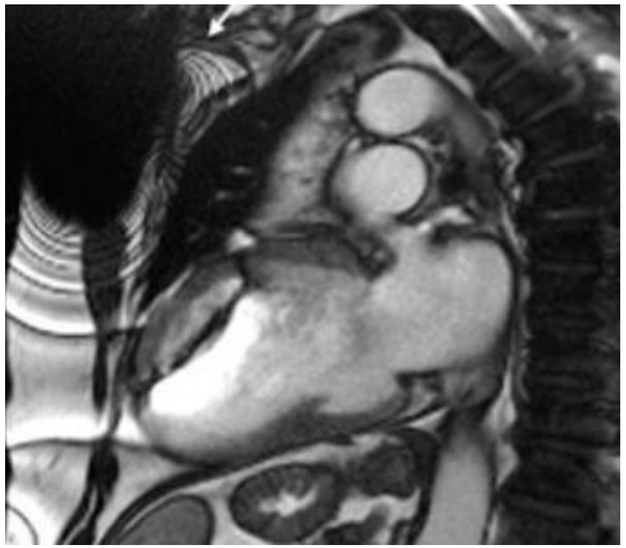
Gestione degli artefatti: off-resonance

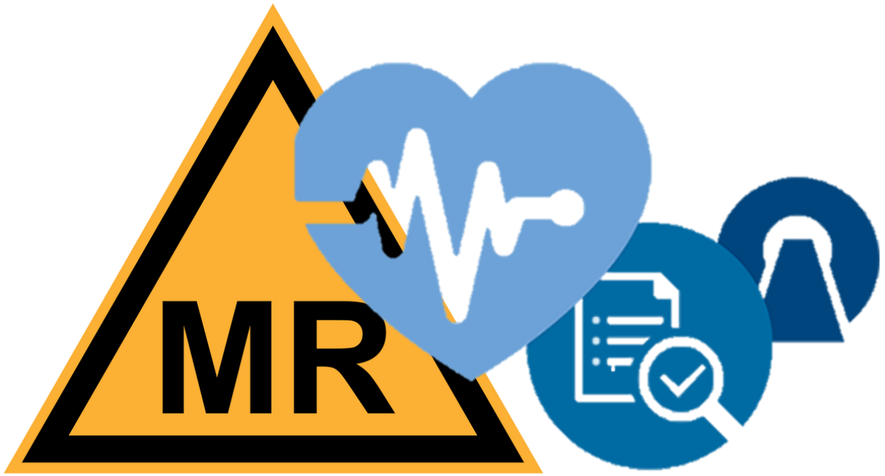




Gestione degli artefatti: off-resonance (device)



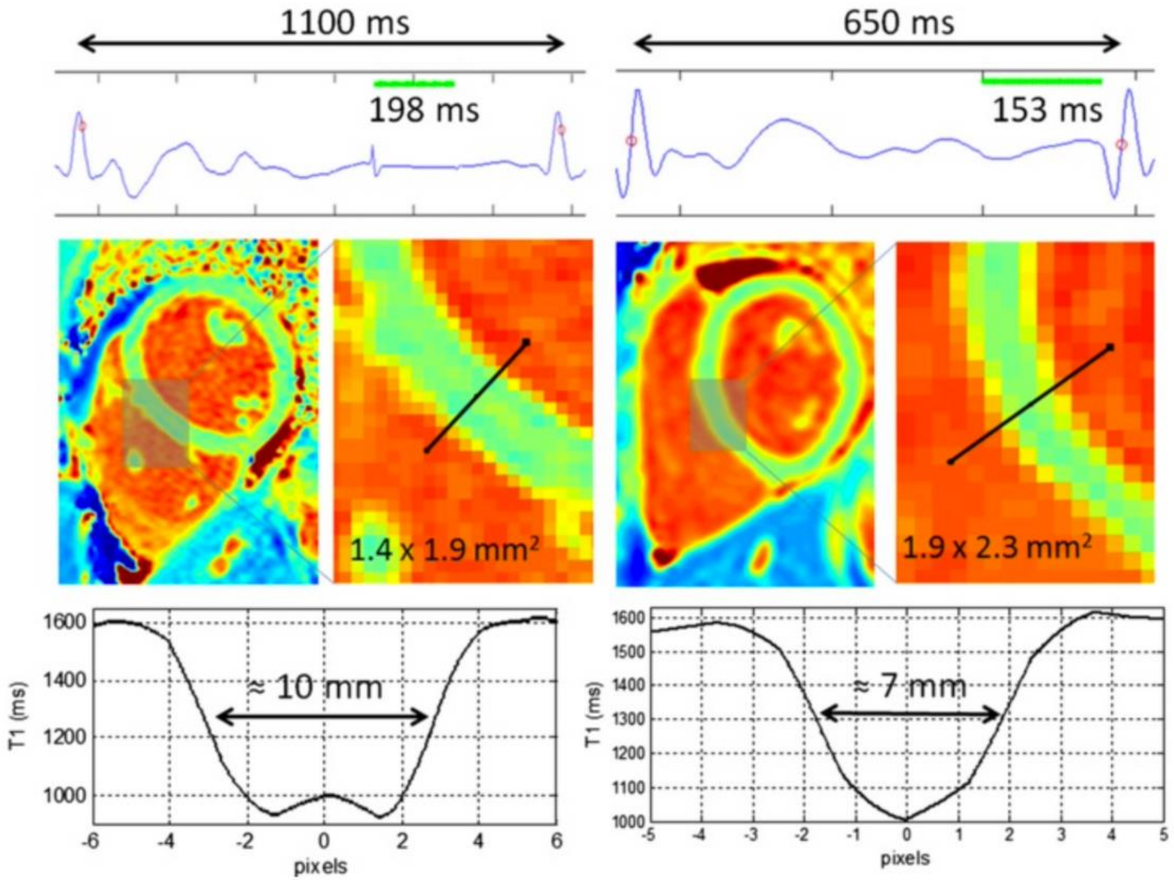




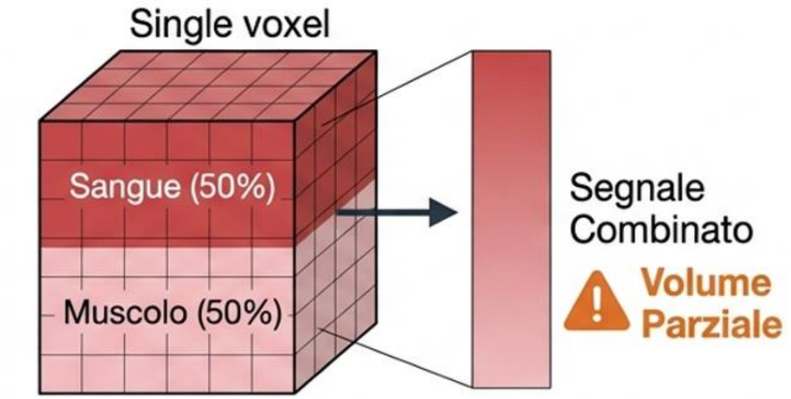
Possibili strategie:

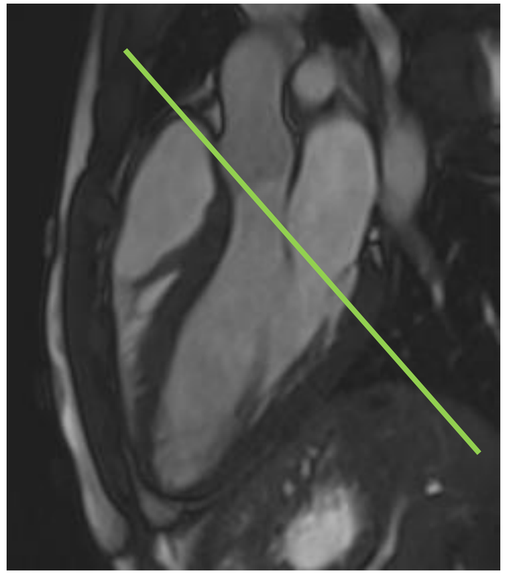
- ✓ Braccio sin alzato
- ✓ Scansione in inspirio
- ✓ Impianto del device a dx
- ✓ 1,5T piuttosto che 3T

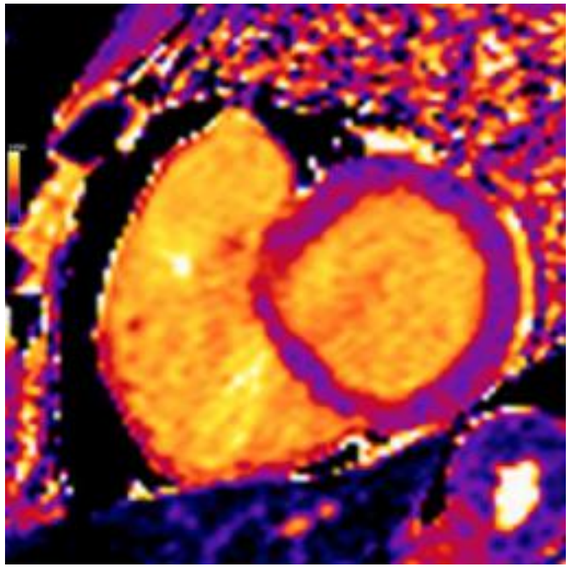
Gestione degli artefatti: volume parziale



256x144 **192x120**







Kellman et al.

Gestione degli artefatti: motion

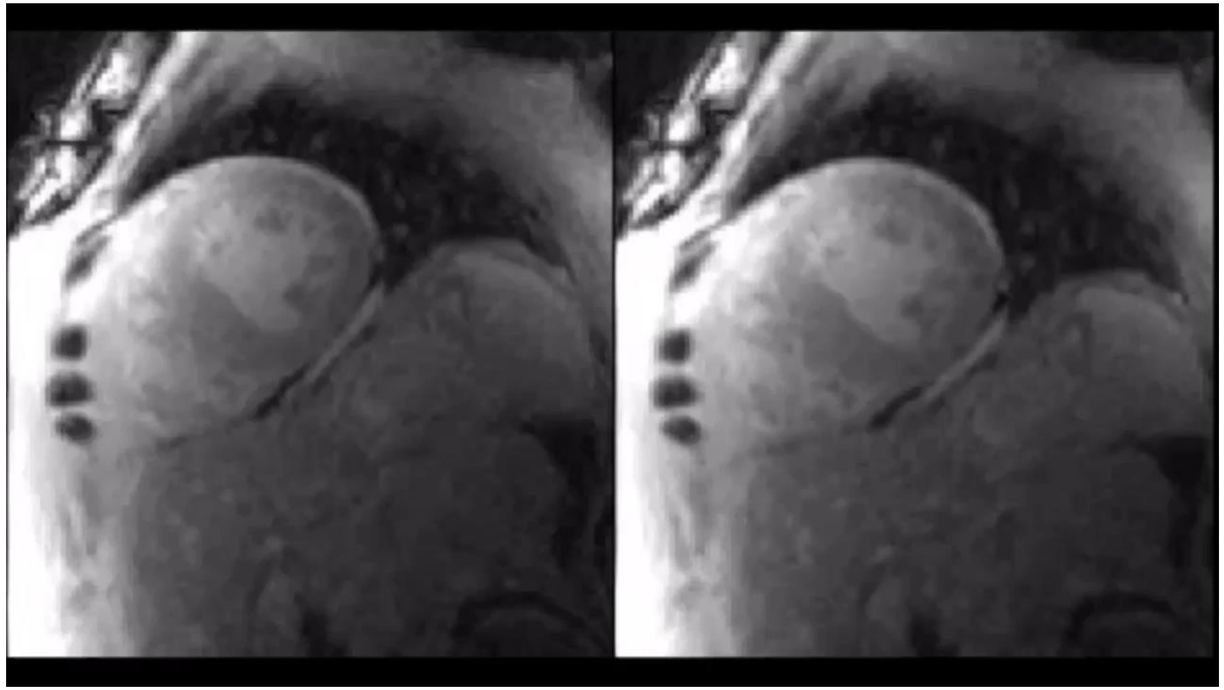
Gli artefatti da movimento, spesso derivanti da movimenti respiratori o cardiaci, aritmie o trigger inadeguati, possono portare a disallineamenti anatomici tra le immagini sorgente.

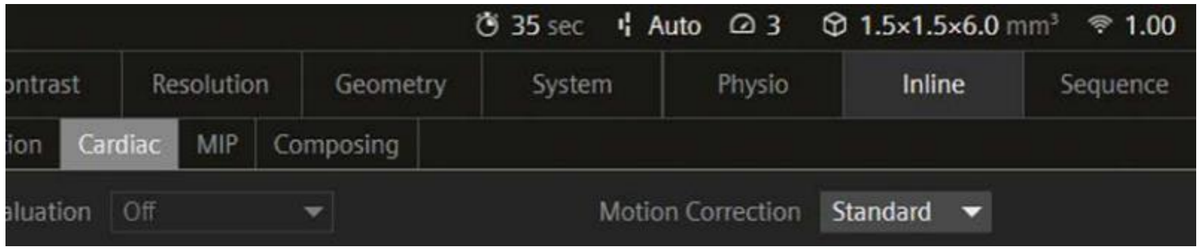
Breath-hold

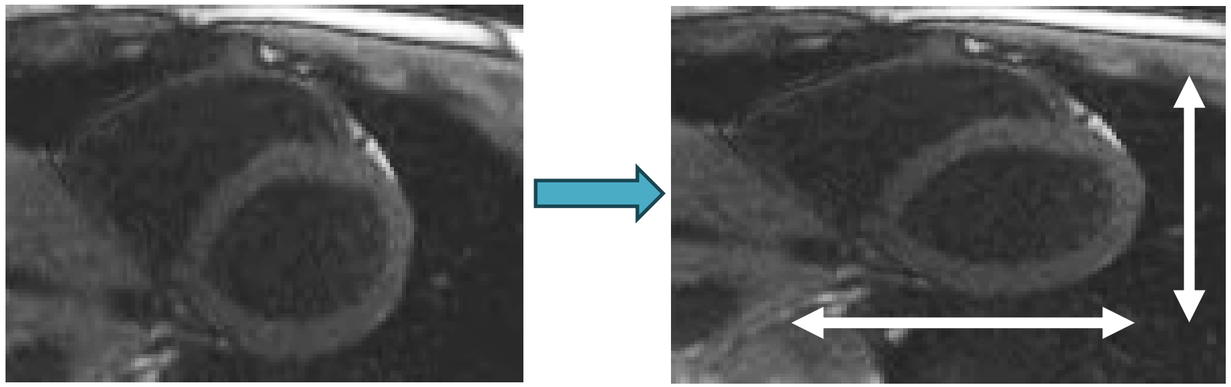
MOCO

Sincronizzazione cardiaca

Gestione degli artefatti: motion correction

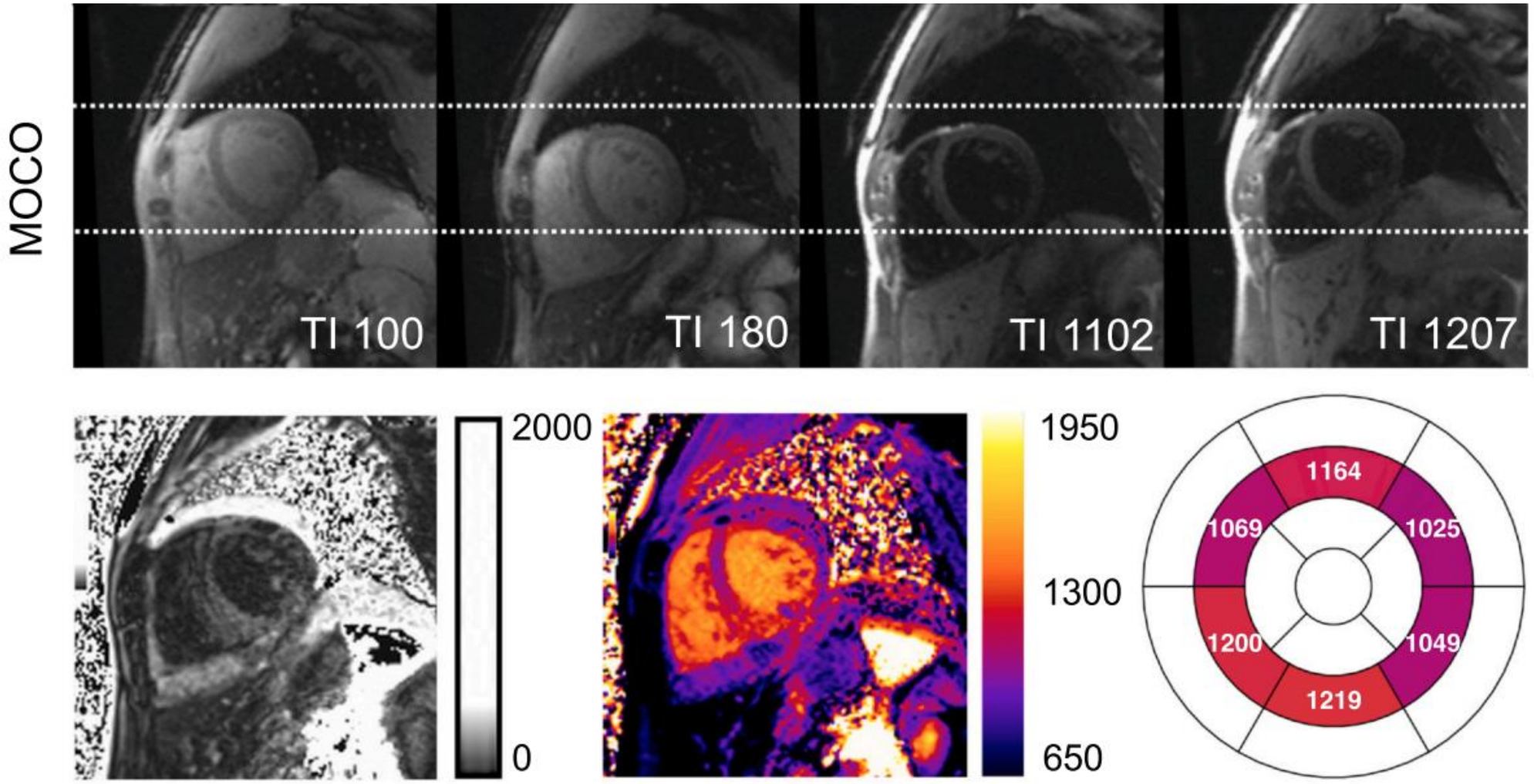






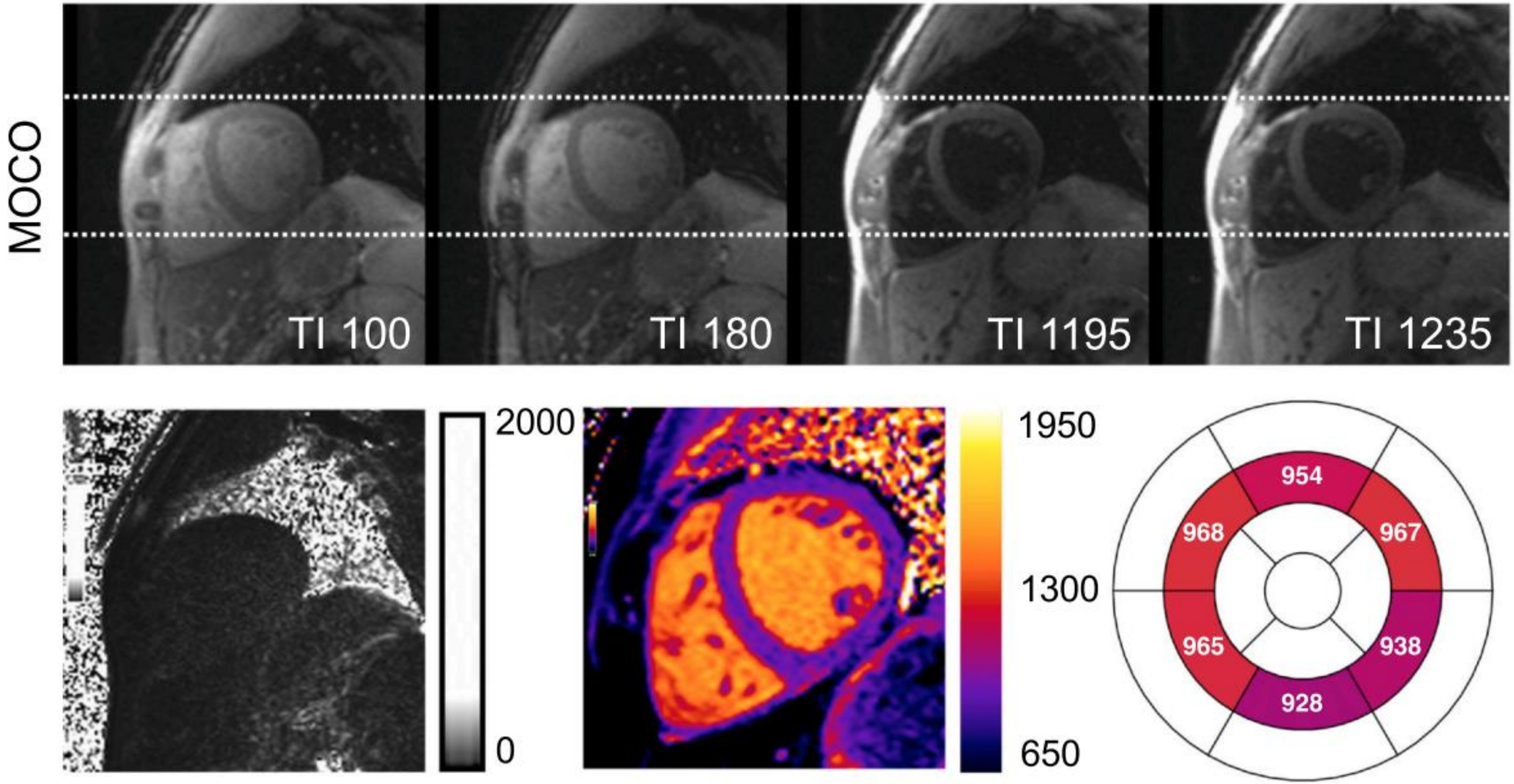
Questi approcci di post-elaborazione utilizzano una varietà di approcci algoritmici e iterativi applicati sia nel dominio dell'immagine che nello spazio-K. Sebbene possano essere efficaci e siano certamente applicabili a qualsiasi immagine acquisita, una volta che i dati sono corrotti dal movimento, non è possibile recuperare i dati ideali.

Gestione degli artefatti: motion correction



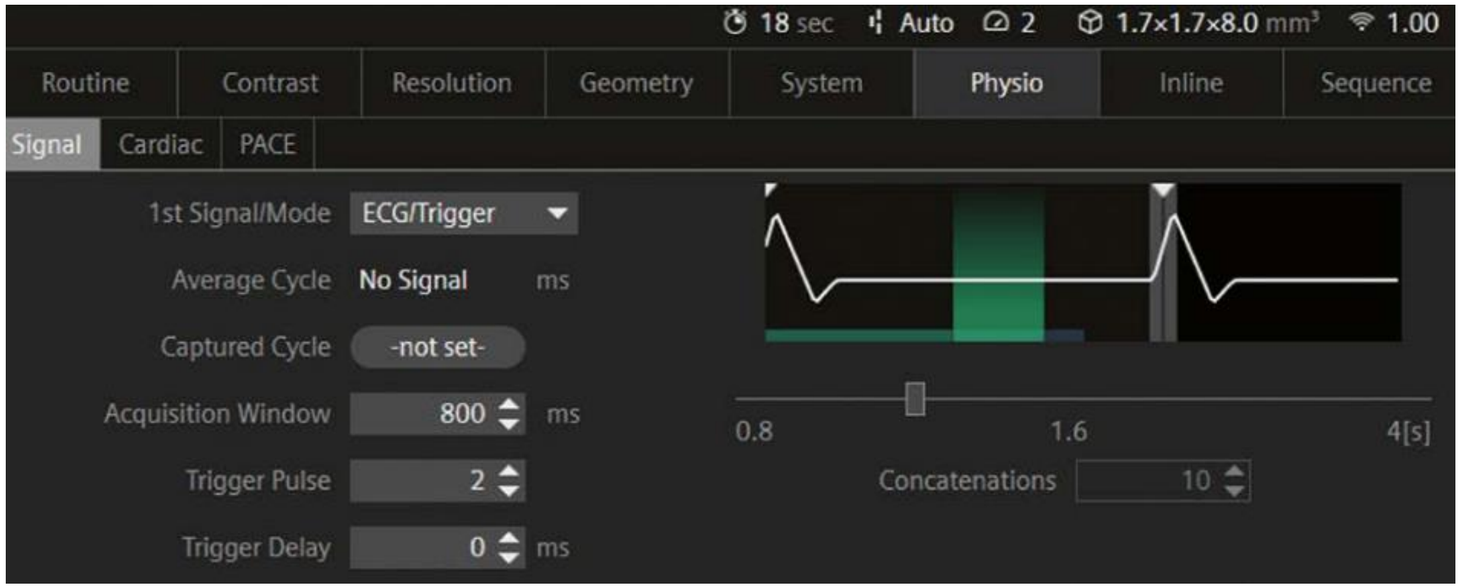
Fenski et al.

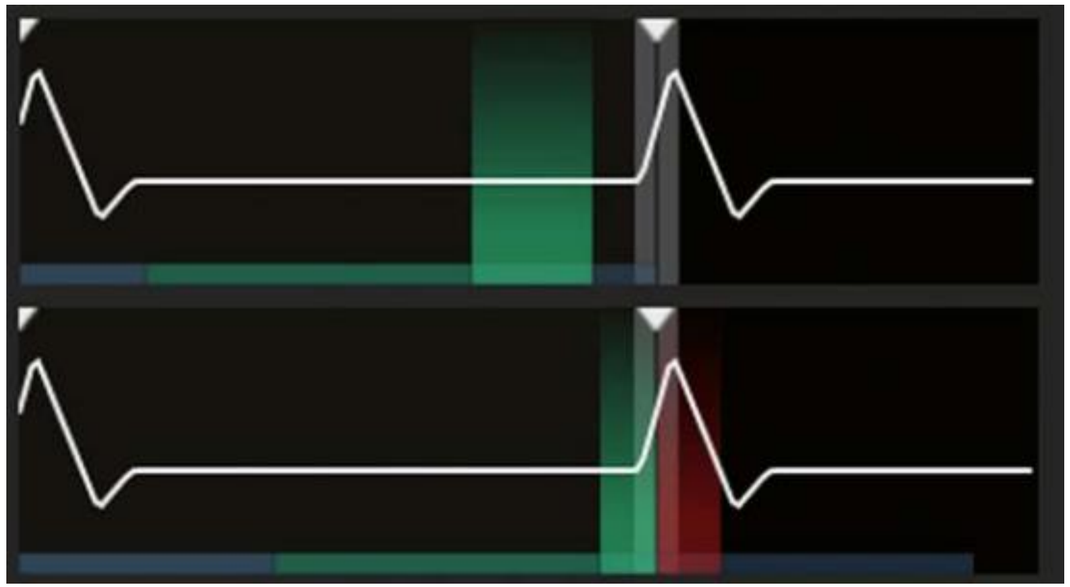
Gestione degli artefatti: motion correction

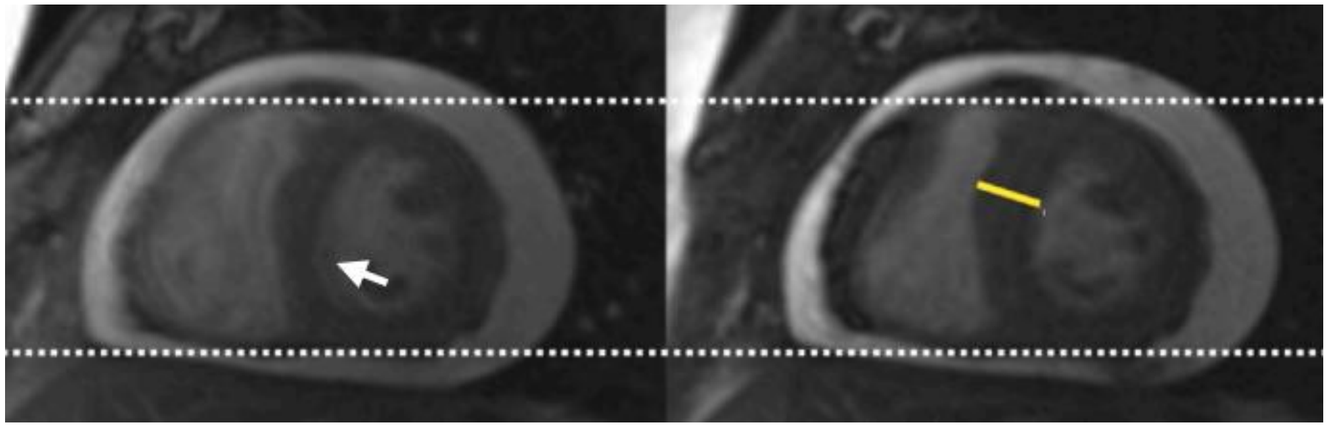


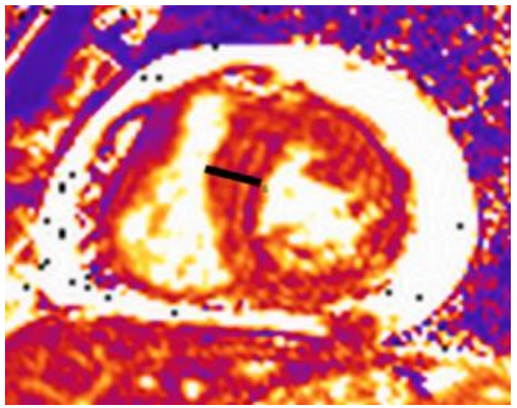
Fenski et al.

Gestione degli artefatti: sicronizzazione cardiaca



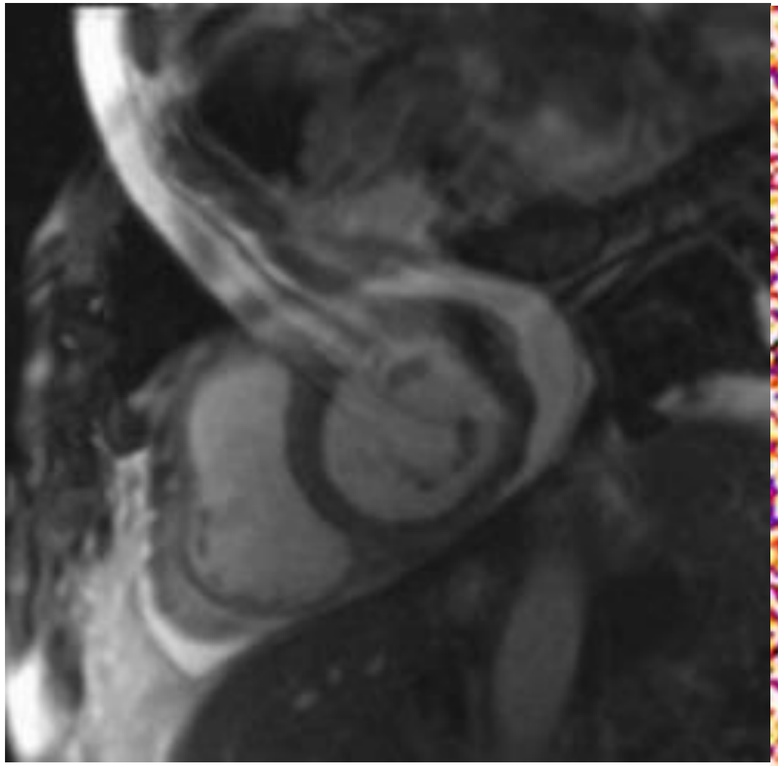


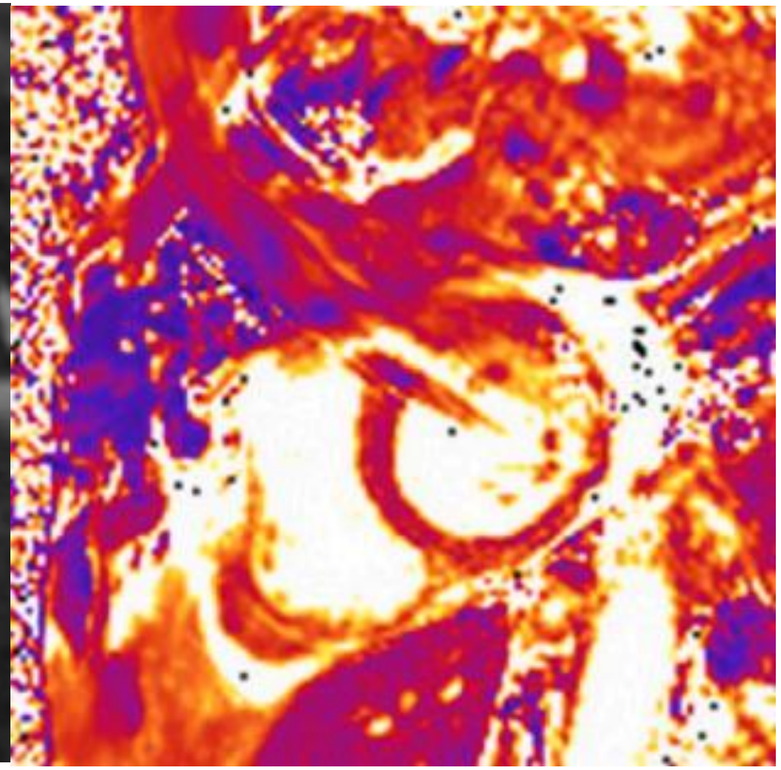




Fenski et al.

Gestione degli artefatti: wrap/folding

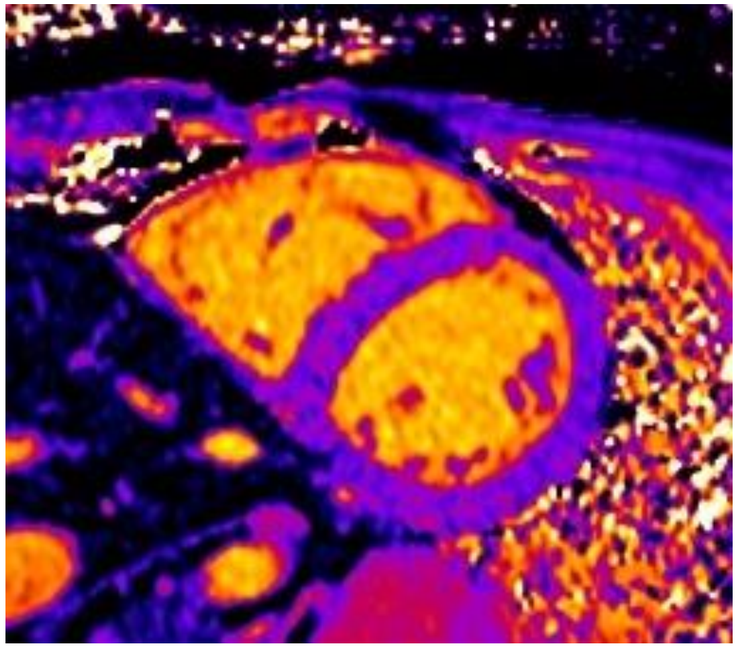


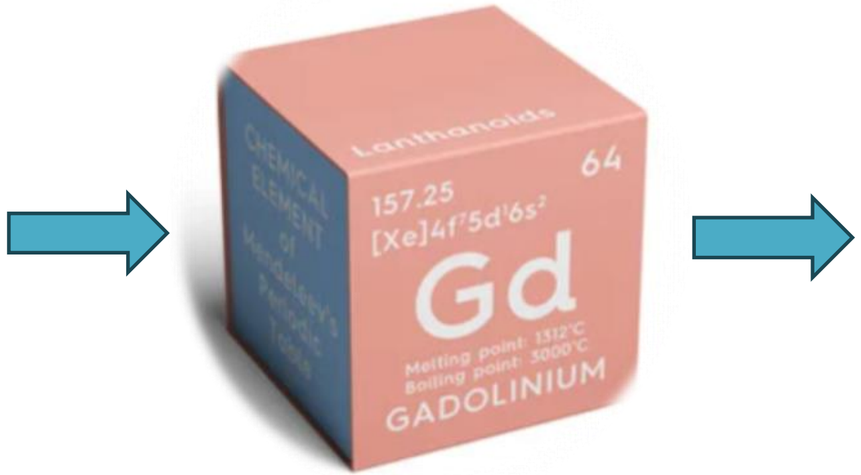


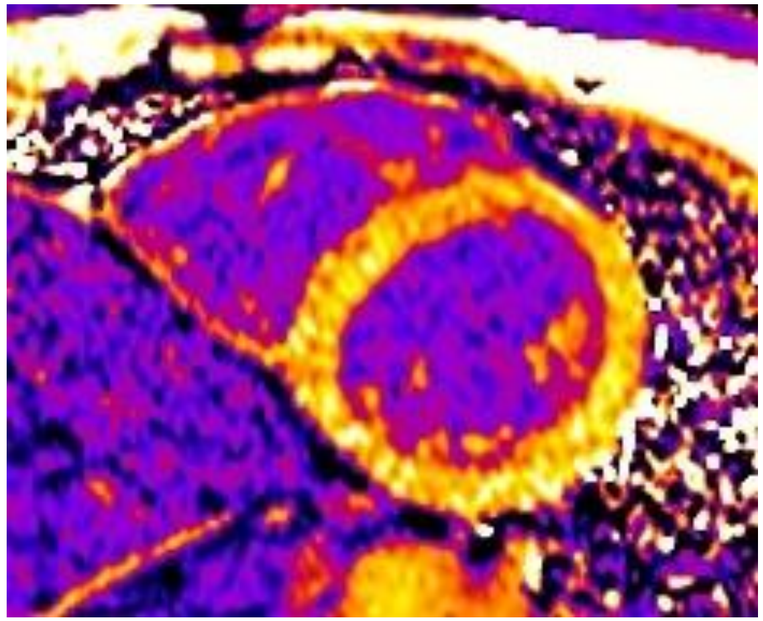
Possibili strategie:

- ✓ Cambiare PE
- ✓ Aumentare FOV
- ✓ Phase oversampling

ECV: Extra Cellular Volume







<u>N.B: acquisire le due mappe con la stessa geometria!</u>

Conclusioni: le regole d’oro per il TSRM

“Una mappa colorata è facile da produrre, ma una mappa accurata richiede rigore tecnico.”

- **Preparation**: Buon segnale ECG e istruzioni respiratorie chiare.
- **Acquisition**: Shim localizzato stretto e scelta sequenza (MOLLI/ShMOLLI).
- **QC:** Verifica delle immagini RAW e mappe di confidenza.
- **Analysis:** ROI conservativa nel setto.