2D imaging

design (x_0(t), y_0(t)) to adequately cover k-space

1) Projection Reconstruction (PR)

\[ \Theta = \tan^{-1}\left(\frac{y}{x}\right) \]

\[ \text{keep } \sqrt{x^2 + y^2} \text{ constant} \]

"Single sided" 2D PR = C

2) "Full spoke" 2D PR

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Reflect in CST

Rec: back-projection

Interpolate k-space data & FFT⁻¹

2D FT imaging "spin warp"

If \( n(x,y) \) is real-valued

\( M(k_x, k_y) \) is Hermitian symmetric
2.

\[
\begin{align*}
\text{RF} & \quad \text{Key} \\
\text{C_x} & \\
\text{G_y} & \\
\text{pad} & \\
\text{most common approach}
\end{align*}
\]

**Sampling Considerations**

\[
\begin{align*}
m(x,y) & \quad \rightarrow \\
\text{complex valued} & \\
M(x,y) & \\
\text{complex valued}
\end{align*}
\]
$$\hat{M}(k_x, k_y) = M(k_x, k_y) \ast \delta(k_x, k_y)$$

Sampled response

Sampling function

$$\sum_j \delta(k_x - k_{x_j}, k_y - k_{y_j})$$

$$m(x, y) = m(x, y) \ast \ast \delta(x, y)$$

True object

Inverse transform of sampling function

Examine 2D FFT

$$\mathcal{F}\{M\} \rightarrow \Delta k_x$$

$$\Delta k_y$$

$$k_x$$

$$k_y$$

$$\mathcal{F}\{\delta(k_x, k_y)\}$$

$$\mathcal{F}\{m(x, y) \ast \ast \delta(x, y)\}$$

$$\mathcal{F}\{M(k_x, k_y)\}$$

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\[ \lim_{n \to \infty} \sigma_n(x) = \sum_{k=-\infty}^{\infty} \delta(x-k) \]

\[ \sigma(k_x, k_y) = \prod \left( \frac{k_x}{\omega_{k_x}} \right) \frac{1}{\Delta k_x} \left( \frac{k_x}{\Delta k_x} \right) \]

\[ \cdot \left( \prod \left( \frac{k_y}{\omega_{k_y}} \right) \frac{1}{\Delta k_y} \left( \frac{k_y}{\Delta k_y} \right) \right) \]

\[ = 2 \prod \left( \frac{k_x}{\omega_{k_x}} \right) \cdot \frac{1}{\Delta k_x \Delta k_y} \left( \frac{k_x}{\Delta k_x} \cdot \frac{k_y}{\Delta k_y} \right) \]

\[ \text{extant} \quad \text{Spacing} \]

\[ \sigma(x, y) = \omega_{k_x} \omega_{k_y} \sin c (\omega_{k_x} x) \sin c (\omega_{k_y} y) \]

\[ \hat{m} = m \otimes \sigma \]

\[ \text{Spacing} \]

\[ \omega_{k_x} \]

\[ \Delta k_x \]

\[ x \]