Beamforming of swept synthetic aperture data requires the angle and radius of rotation of each sub image acquisition. Given these two parameters, the RF data can be properly registered to stitch the low resolution sub images together to generate a single high resolution image. Determining the radius of rotation is

Image processing to locate the point target locations and common points within the subimages

Using the positions of each point target in each sub-image and the recorded angle

Generate a least-squares or some other estimator of the over-constrained system to predict the radius of rotation

Analysis of CRLB, bias in estimator, error analysis, evaluation of different estimators/models etc

Output positions in each sub image would represent the input true positions transformed by a rotation with angle theta and radius of rotation

Notes on deconvolution

* Often use far field approximation to model the PSF for practicality (for normal scans this approx. is only valid for N > a^2/lambda)
* Also derive analytical expressions for PSF for more accuracy
* Some methods use an object function which describes scatterers in the medium (use the object function to calc MMSE as opposed to the PSF – not practical)
* ForWaRD, wavelet based weiner filtering technique WWF (wavelet weiner filter)
* LUT can be used for far field approx. of PSF when performing deconv for speed boost
* Weiner filtering on image domain or the aperture domain RF data? (if aperture domain, what would be the effective psf of a planewave transmit and rx)

Blind deconvolution

* Image output modeled as y = x\*h+n where n is a noise term
* Output image is usually divided into small often overlapping kernels, with each modeled by a stationary convolution model with different PSF – local PSF and reflectivity function are unknown
* Cepstrum is also used to derive PSF – log H is recovered by linear filtering of log spectrum of log G where G = HF g = h\*f and f is the complex reflectivity function

Wavelets deconv

* Cepstrum is the inverse Fourier transform of the log of the FT the signal
* Cepstrum of the resulting image has been observed to result in separable x and h components allowing extraction of psf h
* Deconv process: system function identified via cepstrum methods, tissue signal is estimated by regularized inverse methods (i.e. wiener filtering)
  + Sharp edges from wiener filtering result in ringing
  + Wavelets provide a solution to this ringing
* Neelamani et al. reference 11

Notes on minimum var beamforming

* Spatial smoothing often applied in preprocessing to eliminate the largely coherent (highly correlated) signals in ultrasound images
* Weight ultrasound receive aperture to suppress noise and off-axis signals
* Adaptive filter which dynamically adjusts aperture weights in response to the incoming data
* Weights often calculated by least mean squares methods