# Receiver/Transmitter configuration optimization for compressed computational millimeter-wave imaging

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Millimeter wave (mmw) imaging is gaining popularity in surveillance systems as it provides good tradeoff between high resolution (optical/IR imaging) and high penetration depth (microwave). Conventional mmw Fourier transform based holographic imaging systems (D.M. Sheen et. al., *MTT, IEEE Transactions on* , vol.49, no.9, Sep 2001) require as many measurements as the required space-bandwidth product (M) of the target image. However, in compressed imaging systems (Guy Lipworth et. al., JOSA A, Vol. 30, Issue 8, 2013), apriori knowledge of the target object to be imaged can considerably reduce the number of measurements required. General priors such as sparsity can almost always be used, but more target specific priors can be used for further reducing the number of measurements needed.

The computational imaging model employs a linear relation between a target vector **f** and measurement vector **g**, namely **g = H f**, where the matrix **H** can be derived from the forward propagation model of both the transmitter and receiver fields. When prior knowledge enables compressive sensing, **f** can have a higher dimension than **g**. A variety of methods can be used to invert the above relation, subject to these prior constraints, and obtain the target information **f**.

The results of inversion are most reliable when the singular value spectrum and the condition number of **H** are favorable. We evaluate the SVD spectrum for a variety of transmitter/receiver configurations within a 0.5 x 0.5 meter synthetic aperture. These configurations include the number, positions, and type of radiating antennas used as transmitters and receivers. Positions can be periodic or aperiodic and are subject to constraints on minimum nearest-neighbor distance imposed by the physical size of some proposed transmitters and receivers. Radiating antennas include open waveguide, and horn types.

We investigate the imaging properties of the various configurations both experimentally and numerically. For the experimental work, a scanned synthetic aperture is used with a W-band receiver and transmitter connected to a vector network analyzer.