Technology Portfolio

InView Technology Corporation Introduces World's First Practical High-Resolution Compressive Sensing Camera

Intellectual Property

Researchers at Rice University invented the "Single-Pixel Camera" architecture under a $10M program that culminated in foundational compressive imaging patents that issued in 2006 through 2013. InView Technology Corporation has exclusive license and sub-licensing rights to this fundamental technology from Rice. Using the single-pixel camera concept, InView has developed a computational imaging platform that constructs high-resolution images from low-resolution sensors. InView's compressive sensing architecture represents a significant departure from traditional digital cameras and has particularly strong advantages at shortwave infrared wavelengths where InGaAs arrays are very expensive and typically offer less than a megapixel resolution. **InView's platform is now protected by 15 issued patents and additional applications**, and is embodied in the InView210™ SWIR camera that produces XGA resolution from a single InGaAs detector. At 1024 x 768 pixels, XGA represents nearly twice the pixel count compared to typical SWIR cameras.

InView Technology Corporation is the clear leader in compressive sensing, and continues to enhance its IP portfolio surrounding the implementation of its unique imaging modality. Through a continuous program of funded research and development InView is enhancing the computational capabilities of its compressive sensing platform.

Past projects have:

- Demonstrated adaptive, dynamic pixel exclusion or region-of-interest aggregation for enhanced image dynamic range.
- Developed high-efficiency algorithms for faster imaging and detection

Current projects funded by DoD and NSF grants include:

- Building a compressive *video* camera with high-speed event detection capabilities.
- Demonstrating a multi-spectral camera that creates false-color images combining visible and near infrared wavebands.

Future developments:

- Implement intelligent sensing for automatic information extraction without image construction

InView seeks partners for development and commercialization of its technology and welcomes licensing, investment and acquisition inquiries.

Contact us for more information.

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The following issued US patents are assigned to InView:

Patent No	Title and Description	Issued
14/154,817 ISSUED	**Generating Modulation Patterns for the Acquisition of Multiscale Information in Received Signals** A mechanism for generating modulation patterns in a manner that supports the acquisition of multiscale information in a compressive imager.	2015
US 9,081,731	**Efficient Transforms and Efficient Row Generation for Kronecker Products of Hadamard Matrices** Mechanisms for performing fast transforms based on Kronecker products of Hadamard matrices, and mechanisms for efficiently generating rows of Kronecker products of Hadamard matrices. These are useful in the fast and efficient generation and display of compressive sensing modulation patterns in electronic devices.	2015
US 9,160,914	**User Control of the Visual Performance of a Compressive Imaging System** Mechanisms allowing a user to control performance parameters such as the image quality and/or frame rate achieved by a compressive imaging system	2015
US 8,970,740	**Overlap patterns and image stitching for multiple-detector compressive sensing camera** Designing optimized measurement patterns for multiple-detector CS cameras accounting for crosstalk between sensors. Multiple sensors are used to speed up data acquisition for compressive imaging (also see InView patent **US 8,860,835**).	2015
US 8,860,835	**Decreasing image acquisition time for compressive imaging devices** Mechanisms for speeding up the compressive sensing data acquisition process by dividing the field of view into multiple spatial regions, creating several data streams, and using multiple detectors in parallel.	2014
US 8,885,073	**Dedicated power meter to measure background light level in compressive imaging system** Using the signal from a simple, dedicated power meter to enhance compressive imaging.	2014
US 8,634,009	**Dynamic range optimization in a compressive imaging system** Using differential detection methods and adjustable gain control to maximize the number of bits associated with the digitization of the compressive sensing measurement signal.	2014
US 8,717,463	**Adaptively filtering compressive imaging measurements to attenuate noise** Analog and digital filtering techniques applied to compressive sensing measurements to reduce zero-mean noise.	2014
US 8,717,466	**Dual-port measurements of light reflected from micromirror array** A unique way of making complementary measurements from the modulator used in the compressive camera architecture for inferring variations in light levels that contribute to noise.	2014
US 8,717,484	**TIR prism to separate incident light and modulated light in compressive imaging device** Use of an optical prism device that allows the light path to and from the modulator to be made more compact contributing to a reduction in the size of the compressive camera and the use of standard lenses.	2014
US 8,717,492	**Focusing mechanisms for compressive imaging device** The computational aspect of compressive sensing is used for the manual and automatic focusing of compressive sensing cameras.	2014
US 8,717,551	**Adaptive search for atypical regions in incident light field and spectral classification of light in the atypical regions** Algorithms and implementations for detecting and classifying anomalous regions in the field of view of a compressive camera.	2014
US 8,760,542	**Compensation of compressive imaging measurements based on measurements from power meter** Using power meter measurements of calibration patterns and other techniques to significantly decrease noise levels in compressive sensing measurements and increasing	2014

Patent No	Title and Description	Issued
	image quality.	
US 8,922,688	**Hot spot correction in a compressive imaging system** Adaptive control of the modulator within the compressive camera architecture provides the means for automatically aggregating or removing regions in the field of view of a compressive camera that are excessively bright or otherwise of interest or not typical for the scene.	2014
US 8,570,406	**Low pass filtering of compressive imaging measurements to infer light level variations** A method for compensating for background light level variations experienced during compressive measurement acquisition by low-pass filtering the measurements.	2013
US 8,570,405	**Determining light level variation in compressive imaging by injecting calibration patterns into pattern sequence** A method for compensating for background light level variations experienced during compressive measurement acquisition using calibration patterns within the series of modulation patterns for compressive imaging.	2013

The following US patent applications are assigned to InView:

Patent Application No.	Title
14/341,361 20150029503	**Simplified Compressive Sensing Spectral Imager**
14/527,459 20150116563	**Adaptive Sensing of a Programmable Spatial Light Modulator System**
14/168,473 20140211000	**Sensing Signals with Affine-Harmonically Related Rows of Kronecker Product Matrices**
14/137,206 20140297703	**Signal Reconstruction Using Total-Variation Primal-Dual Hybrid Gradient (TV-PDHG) Algorithm**
13/664,289 20130128042	**High Speed Event Detection Using Compressive Sensing Hyperspectral Imaging Architecture**
13/534,414 20130002715	**Image Sequence Reconstruction based on Overlapping Measurement Subsets**

The following are Rice University patents exclusively licensed by InView:

Patent No	Title	Issued
US 8,848,091	**Method and Apparatus for Compressive Imaging Device**	2014
US 8,725,784	**Method and Apparatus for Compressive Domain Filtering and Interference Cancellation**	2014
US 8,487,796	**Automatic Gain Control for Nonzero Saturation Rates**	
US 8,483,492	**Method and Apparatus for Sparse Signal detection, Classification, and Estimation from Compressive Measurements**	2013
US 8,456,345	**Signal Reconstruction from Saturated Measurements**	

Patent No	Title	Issued
US 8,199,244	**Method and apparatus for compressive imaging device**	2012
US 7,783,459	**Analog System For Computing Sparse Codes**	
US 7,511,643	**Method and apparatus for distributed compressed sensing**	2009
US 7,271,747	**Method and apparatus for distributed compressed sensing**	2007
ISSUED	**Compressive sensing through Multiplexed Modulation**	
pending	**Method and Apparatus for Compressive Imaging Device Having Startle Reflex**	
pending	**Temporally and Spatially Resolved Single Photon Counting Using Compressive Sensing for Use in Integrated Circuit Debug and Failure Analysis**	

REFERENCES AND FURTHER READING

1. M. A. Herman, et al., **"Recent results in single-pixel compressive imaging using selective measurement strategies,"** Proc. SPIE v. 9484, 9494-09 (2015).
2. J. Tidman et al.,"**Compact opto-electronic engine for high-speed compressive sensing** ", Proc. SPIE 8856, Applications of Digital Image Processing XXXVI, 885616 (September 26, 2013).
3. M. A. Herman, et al., "**A higher-speed compressive sensing camera through multi-diode design** ",Proc. SPIE 8717, Compressive Sensing II, 871706 (May 31, 2013).
4. M. Herman, **"Compressive Sensing with Partial-Complete, Multiscale Hadamard Waveforms,"** in Imaging and Applied Optics, OSA Technical Digest (online) (Optical Society of America, 2013), paper CM4C.3. http://www.opticsinfobase.org/abstract.cfm?URI=COSI-2013-CM4C.3
5. L. McMackin, et al., "**Low-cost, High-resolution Shortwave Infrared Microscope Camera Based on Compressive Sensing**," in *Optics in the Life Sciences*, OSA Technical Digest (online) (Optical Society of America, 2013), paper NTh2B.4.
6. L. McMackin, et al.,"**A high-resolution SWIR camera via compressed sensing**", Proc. SPIE 8353, Infrared Technology and Applications XXXVIII, 835303 (May 1, 2012).
7. C. Li, et al., "**A Compressive Sensing and Unmixing Scheme for Hyperspectral Data Processing**," *Image Processing, IEEE Transactions on* , vol.21, no.3, pp.1200, 2012.
8. T. A. Russell , et al.,"**Compressive hyperspectral sensor for LWIR gas detection** ", Proc. SPIE 8365, Compressive Sensing, 83650C (June 8, 2012).
9. Baraniuk, Richard G. "**Compressive sensing**." IEEE signal processing magazine 24.4 (2007).
10. Baraniuk, Richard G. "**Single-pixel imaging via compressive sampling**." IEEE Signal Processing Magazine (2008).

Compressive Sensing: The Big Picture - https://sites.google.com/site/igorcarron2/cs
Compressed sensing - http://en.wikipedia.org/wiki/Compressed_sensing

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About the Company

InView Technology Corporation is the clear leader in Compressive Sensing, and continues to enhance its IP portfolio surrounding the implementation of its unique imaging modality. InView's team has deep experience in CS mathematics and algorithms, opto-mechanical system design, hardware and software design, and understands techniques required to build practical, high-volume CS cameras.

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