Efficient Shortwave Infrared Imaging and Analytics Using Compressive Sensing

**InView introduces the world’s first high-resolution SWIR camera built on a Compressive Sensing platform**

*For applications in microscopy, scientific imaging, and automated monitoring*

Compressive Sensing is an innovative data sampling strategy that exploits the fact that signals and images are often sparse in some transform basis. By sampling in the correct transform space, imaging and machine vision processing tasks can be efficiently performed from far fewer measurements than traditionally required by Nyquist sampling rules.

**InView210™ SWIR Scientific Imager**

The InView210™ produces shortwave infrared images with up to 1024 x 768 pixels. That’s nearly twice the pixel count of typical SWIR cameras. Using the patented “Single-Pixel Camera” architecture, InView has eliminated the need for costly InGaAs focal plane arrays, trading off high camera costs for a slower frame rate useful in many microscope applications.

Covered by US Patents: 8,199,244 and 8,848,091
CompressView™ User Interface

CompressView™ software is an easy to use interface developed in-house exclusively for use with InView’s Compressive Sensing-based cameras. The application is designed to manage camera setup, data capture, image display and processing. The software comes included with every SWIR camera and is compatible with virtually any Windows based PC. For the more experienced user, default parameters for can be easily changed using scroll down menus. While an intuitive experience, CompressView™ also contains the camera’s API so is scalable and configurable for new application specific software packages as they are developed.
New Developments at InView CS Video Camera

Having already harnessed the computational power of the famous Single-Pixel-Camera design, InView has now enhanced its speed by incorporating a small array of pixels and new compressive computational methods. InView takes advantage of parallel measurements, matrix processing and fast efficient global reconstruction algorithms to produce high-resolution SWIR video frame rates of 5-10 frames per second. The multi-diode platform has led to innovative algorithms that work efficiently across multiple data regions and at multiple resolution scales simultaneously.

Covered by US Patents: 8,970,740; 9,081,731; and 9,277,139 B2

These images show how multi-pixel Compressive Sensing magnifies the resolution of a small pixel array. On the left, is a low-resolution image directly measured from a 64 x 64 InGaAs pixel array. When that same 64 x 64 array is used with compressive sensing, the image is transformed computationally into a detailed 512 x 512 image. InView’s proprietary global image reconstruction algorithms are used to process multi-pixel data eliminating the need to individually stitch parallel image elements together.

Streaming Spatial Light Modulator:

InView223™ Compressive Sensing Engine

There are over 5000 papers a year published on compressive sensing. However, building a CS system is a time-consuming task. Many research groups around the globe would benefit from being able to buy a DMD-based compressive sensing engine made for immediate integration into benchtop experiments. The InView223™ provides a streaming alternative to batch-mode DMD development kits giving researchers the ability to apply novel 1024×768 modulation patterns to an XGA resolution digital micro-mirror device with full electronic functionality for compressive sensing, computational
photography, structured illumination and a host of other dynamic light modulation and control

**Multi-Spectral CS Camera**

InView is developing a multi-spectral CS camera capable of imaging throughout the entire visible AND SWIR wavelength range with no loss of spatial resolution. The camera prototype, developed through a grant from the National Science Foundation will be completed in 2016.

*Covered by US Patent Application: 20150029503*

**Simplified Compressive Sensing Spectral Imager**

**More Research at InView Technology Corporation**

InView continuously enhances the computational capabilities of its compressive sensing platform with innovations to its algorithms and architecture. InView has demonstrated:

Adaptive algorithms that dynamically exclude saturated pixels to improve overall signal-to-noise performance in high dynamic range imaging

Region-of-interest pixel aggregation for high speed image foveation

Compressed-domain processing for efficient target detection, classification and tracking without the computational burden of image construction

InView is demonstrating that new compressed-domain machine vision algorithms can automatically detect and classify targets from even fewer measurements. This is possible because our algorithms significantly reduce the dimensionality of high resolution data without losing information. InView proposes to apply compressed-domain processing to high-speed computer assisted diagnostics for efficiently finding information in large digital data sets.

*Covered by US patents: 8,717,551 and 8,922,688*

InView’s compressive sensing architecture is an intelligent platform for quickly and automatically extracting information from a scene without image data overload. We constantly seek to reduce the number of measurements needed for imaging and target detection while increasing frame rates. See these papers for more information:


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Compressive sensing gives the InView210™ platform a very different architecture than common digital cameras. It is a unique combination of optical components, electronics and algorithms. In compressive sensing, a scene is observed using a measurement matrix implemented row by row as patterns displayed on a high-speed digital micromirror array. Each pattern represents a basis function from a set that optically projects the scene onto a mathematical representation that significantly reduces its dimensionality without losing information. The scene is modulated then focused to a single detector. Using proprietary processing techniques, the low dimensional data vector constructs high-resolution images from measurements numbering only a fraction of the number of pixels that are constructed. InView is now demonstrating that new compressed-domain machine vision algorithms can automatically detect and classify targets from even fewer measurements. InView proposes to apply these new processing techniques to efficiently find information in large digital data sets for high-speed pattern recognition and diagnostics. More information can be found at: www.inviewcorp.com.

Compressive Sensing Architecture: the scene is imaged onto the micromirror array, optically encoded using a set of modulation patterns and then focused onto one or a small number of detectors. For each modulation pattern, one measurement is taken and added to a data vector used to construct and image or efficiently process the data in the compressed domain.
InView Technology Corporation

The world’s leader in revolutionary Compressive Sensing technology

- Austin-based, privately-held, Delaware C Corp, founded in 2009
- Commercialized the world’s first high-resolution shortwave IR camera based on Compressive Sensing: $267,000 in product sales to date plus $3M in research grants to develop video and machine vision capability;
- **Solid First-Mover Position:** EXCLUSIVE license to foundational IP developed from $10M in government-funded R&D at Rice University; **16 issued patents and additional applications surrounding technology required to build practical, high-volume CS cameras**

Issued US Patents: 9,277,139 ; 9,160,914 ; 9,081,731 ; 8,970,740 ; 8,922,688 ; 8,885,073 ; 8,860,835 ; 8,760,542 ; 8,717,351 ; 8,717,492 ; 8,717,484 ; 8,717,463 ; 8,717,466 ; 8,634,009 ; 8,570,406 ; 8,570,405

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<th>Product</th>
<th>Features</th>
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<tbody>
<tr>
<td>InView210 SWIR Camera</td>
<td>1024x768 resolution, 1/3 FPS</td>
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<td>InView223 Compressive Sensing Engine</td>
<td>Computer controlled DMD</td>
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<tr>
<td>Compressive Video Camera</td>
<td>5-10 FPS</td>
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<td>CS Target detection and tracking Algorithms</td>
<td>ATR without imaging</td>
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<td>Multi-spectral CS camera</td>
<td>Vis-NIR-SWIR</td>
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- InView’s new compressed-domain machine vision algorithms efficiently find information in large digital data sets for faster workflows in Computer Aided Diagnostics.
- Positioned for sale, licensing, joint ventures and manufacturing partnerships to bring CS technology to the next level

**Dr. Lenore McMackin**  
*President/CTO*

Lenore has held senior technical and executive roles in display, opto-electronic and semiconductor industries demonstrating expert technical vision, interdisciplinary team building and effective interaction at all corporate levels. She has been awarded millions of dollars in research grants and has over 40 technical publications. She has a PhD from the University of Rochester, is a Fellow of the Optical Society of America, and has served on OSA’s board.