



## **SBIR Commercialization Assistance Program**

### **3D Video**

*Based on Spatial Phase Imaging*

#### ***Business Opportunity:***

Annual sales of three dimensional (3D) products and services have grown over the past two decades from essentially nothing to more than \$50 billion. Yet sales of 3D sensors, the three dimensional equivalent of digital (2D) cameras, are currently less than \$200 million. Today's 3D sensors are simply too bulky, complex and expensive to be used in most applications. What if 3D sensors were as easy to use as digital cameras? What if they were about the same cost? There is no doubt that 3D applications in major sectors of the world economy would explode. Most of the \$30 billion in annual global sales of digital cameras would rapidly shift to 3D cameras.

Photon-X has developed the world's first practical 3D camera technology: Spatial Phase Imaging (SPI). We are growing rapidly and profitably. We are looking to develop strong strategic and exclusive partnering relationships to help us introduce SPI cameras to the world.

#### ***Company Background:***

Photon-X, Inc. was founded in 2001 and currently has about 20 scientists, engineers and staff people. We are headquartered in Huntsville, Alabama and have satellite offices in the Washington, DC; Dayton, Ohio and Los Angeles, CA. Photon-X has historically been a government/defense R&D company, but is now in the process of adding a product development division to produce SPI sensors and cameras for government and commercial customers. Photon-X currently supports about 20 government and defense customers including Wright-Patterson, ONR, SPAWARS, Raytheon, and Northrop Grumman.

#### ***Industry Problem:***

There are three fundamental functions that must be adequately addressed for 3D activities to continue growing at a healthy rate: sensing (physical objects to digital models), processing (digital to digital) and interacting (digital back to physical world). Of the three functions, sensing currently represents the biggest bottleneck to 3D industry growth. 3D sensors are simply too bulky, complex and expensive to be justified in most applications.

#### ***Technology:***

There are three basic characteristics of natural light: frequency, intensity and phase (also called polarization). With unaided vision, humans see the first two characteristics as color and brightness respectively. But, humans are generally unable to perceive the phase state of light. (Some animals, particularly sea creatures that benefit from seeing through cloudy water, actually see using phase.) It turns out that when natural light reflects off of natural surfaces, its spatial phase is effected in such a way that the orientation of the object's surface can be determined. Thus, Photon-X SPI sensors actually "see" the world in three dimensions. Compact, cheap, easy to use 3D cameras based on SPI technology will enable the rapid growth of important 3D applications by resolving major limitations in 3D sensing that we are experiencing today.

### ***Advantages and Differentiating Feature:***

Cameras based on SPI technology will look and “feel” like conventional digital cameras. They will be compact, high definition, simple to operate, fast and inexpensive. They will operate passively where required using long-wave infrared energy or sunlight. Because they are true line of sight devices (single lens), they will capture 3D images at long ranges.

However, unlike conventional cameras, which record an image of the world that effectively “throws” the third depth dimension away, SPI cameras will record the world as it really exists... in three dimensions. So, one will be able to use a 3D camera, for example to create a detailed three dimensional model of a person by pointing at the person and moving around the person. One will be able to use a SPI camera to record and broadcast in three dimensions so that people observing a 3D display can see the programming in true 3D.

### ***Stage of Development:***

Photon-X is a small, profitable R&D company that is experiencing rapid growth as increasing number of government projects are secured and executed. With the help of TRDA, Photon-X has developed its first comprehensive plan for commercializing its SPI technology. The plan defines important tasks related to intellectual property, fundraising and product definition, which are now well under way.

### ***Competing Technologies:***

There are three technologies that compete with SPI: Time of Flight Imaging (“TOF”), stereoptic imaging (“STO”) and stereo correspondence (“STC”). TOF cameras measure the round trip time required for light to travel from a source to the object and back again. STO cameras capture two images of the same scene slightly offset (as human eyes are offset). STC cameras sense corresponding intensity features in images captured from two viewpoints and use triangulation mathematics to compute geometry. TOF cameras have very coarse resolution that render them unacceptable for applications requiring photographic quality. STO cameras do not create digital models that can be edited and processed—rather they require a human mind to process two images in order to create a notional impression of depth in the mind of the person. STC cameras require dense and consistent texture (e.g. freckles on a face) to work properly—many objects do not have sufficient texture. These technologies all have important applications, but SPI will likely occupy a dominant position in the 3D Industry for reasons described.

### ***Applications & Benefits:***

Digital cameras are used in almost every sector of the global economy. Most households and organizations, for example, have more than one. Similarly, SPI is a platform technology. SPI sensors and cameras will be used in major sectors including: security (e.g. biometric identification at distance); entertainment (e.g. 3DTV); defense (e.g. Target Detection, Terrain Analysis, Surveillance, Unmanned Vehicles, Personnel Scanning, Battle Damage, Quality Inspections, Robotics, Training and Documentation); medical (e.g. cosmetic surgery); consumer (e.g. apparel over the Internet); manufacturing (e.g. 3D printing) and construction (e.g. virtual walkthroughs).

### ***Intellectual Property:***

Photon-X owns three issued US patents, US5557261, US6671390 and US6810141, and has three pending patents, two of which are being prosecuted internationally. The patent portfolio covers the fundamental SPI technology, general systems that make use of SPI technology, and several key applications.