

## *Summary*

A specialist in applying or creating mathematical methods to solving problems of developing technologies. A rare expert in solving problems starting from the stage of a stated “word problem” to proof of concept and production software development. Such successful uses of an educational background in mathematics, intellectual courage, and tenacious character include:

- developed a unique method of statistical analysis of spectral composition in 1D and 2D stochastic processes for quality control in ultra-precision mirror polishing
- developed novel methods of detection, tracking and classification of small moving targets for aerial IR and EO sensors. Used SIFT, and SIRF features, and developed innovative feature-signatures of motion of interest.
- developed image processing software for bioinformatics, point source (diffraction objects) detection semiconductor metrology, electron microscopy, failure analysis, diagnostics, system hardware support and pattern recognition
- developed statistical software for surface metrology assessment, characterization and generation of statistically similar surfaces to assist development of new optical systems
- documented, published and patented original results helping employers technical communications
- supported sales with prototypes and presentations
- worked well with people – colleagues, customers, researchers, scientists, engineers

## *Tools*

**MATLAB, Octave, OpenCV, ImageJ, Scion Image, Aphelion Image, Gimp, PhotoShop,**  
**C/C++, (Visual C environment), GNU development tools,**  
**UNIX (Solaris, SGI IRIX), Linux, Windows, MS DOS.**

## *Positions and Experience*

***Second Star Algonumerixs – 2008-present,***

***founder and CEO***

<http://www.secondstaralgonumerix.com/>

**1) Developed a method of statistical assessment, characterisation and generation of random surface metrology for super precision X-ray mirror manufacturing in collaboration with Lawrence Berkeley National Laboratory of University of California Berkeley. The work resulted in several publications and the SBIR proposal based on the research was selected for award by NASA in April 2015. The contract number NNX15CM48P was awarded on June 17, 2015**

Created a mathematical method to analyse spectral (frequency) composition of 1D and 2D stochastic processes to analyze quality of polishing of ultra-precision X-ray mirrors. Developed a statistical method (and prototype software) to analyze the polishing process. We were able to use the numerical analysis to propose quality indicators for the surfaces that can be used as a feedback for polishing machines and the algorithms that drive the deterministic polishing process. The method also allows for a significant saving in a very expensive metrology and repolishing cycle by reducing (up to 75%) of the required metrology measurements. The results of the works were presented at four SPIE sponsored conferences and published in a few peer reviewed journals.

**2) Developed a new method for resolution of point sources beyond Rayleigh criteria.**

Patented the method- notice of allowance received in 2014. Created a proprietary software embodying the algorithm.

***Neurithmic System – Newton, MA – 2014***

***Consultant***

Working on mathematical modeling for sparse representation deep learning cognitive processing model. Created new computational methods to estimate informational content in sparse learning storage structures created from images and video signals, based on compressive sensing methods. The project was geared to human gesture recognition in video segments.

***Intelligent Biosystems, Waltham MA 2012-2013***

***Consultant***

Troubleshooting image processing algorithms, software and imaging system to estimate the relative contribution of the sources of error in the existing image processing pipeline and imaging hardware. Reduced system error by a factor of 2.5.

***Scientific Systems Company Inc, Woburn, MA 2008 to 2013***

***Senior Engineer/ Senior Scientist***

**Presented successful grant proposals for SBIR government grants, planned and completed research projects, wrote prototype software and conducted required research and testing; presented written reports to sponsors and at conferences. Some results were published and presented at SPIE conferences in 2011, 2012, and 2013.**

- Created a new method of ballistic target recognition by application of methods developed by the Computational Cognitive Science Group at MIT.
- Worked on image processing and compression for Synthetic Aperture Radar (SAR) signal.
- Developed novel methods of detection, tracking and classification of **small moving targets** for aerial IR and EO sensors. Used **SIFT** and **SIRF** features, and developed innovative feature-signatures of motion of interest.
- Developed a **method of image reconstruction** through **turbulence** for **video signal**.
- Developed **Step Detection** algorithms for **acoustic and seismic data**.
- Created software for **moving objects classification in aerial video signal**.
- Developed innovative **kinematic features to characterize moving objects in video signal of low resolution**. The features are descriptive of gait of moving targets.

***Helicos BioSciences , Cambridge, MA 2005 to 2008***

***Principal Software Engineer/ Senior Scientist***

**Worked on image processing and extraction of point sources. Created software for object detection of point sources, registration of object tables and strand formation of detected and registered objects -incorporation events into sequences (of DNA bases).**

- Developed algorithms and software to detect randomly distributed point sources (aka diffraction limited objects). Lowered the separation distance necessary for resolution of two sources to less than a half of previously known limit (**Rayleigh criterion and Sparrow limit**). Improved error rates in single molecule sequencing 12 times over the leading astronomy software
- (see <http://sextractor.sourceforge.net/> ).
- Developed test sets and assessment tools to compare different processing methods.
- Developed registration software for correlation of object tables.

- Developed image based hardware QA diagnostic software.
- Developed a tracking Pipeline to form strands out of detected objects complete with error budget controls that enable the end-user to pick the error and throughput to control the Image Processing Error dependence on density of randomly distributed strands.
- Sped up the initial Object Detection Software over 100 times partly by speeding up the computations and partly by delegating some of the computations to off-peak times. That allows the image processing to run in real time without saving the image data (measured in 100s of terabytes, if stored).

#### **SenTech Acoustics, Stoneham, MA 2004**

**Consultant**

Worked on footstep detection algorithms based on processing of a seismic signal. Developed analysis of likelihood of detection, failure to detect and false detection under varying conditions.

#### **Schlumberger, ATE, Concord, MA 1997 to 2003**

**Senior Software Engineer**

*Worked on problem identification, software implementation, creation of design documentation and a testing program. Designed and coded prototype software, tested it. Worked in Matlab, C/C++, PhotoShop, Aphelion Image. Led a team of software engineers and application specialists to final implementation, integration and testing. Projects high lights:*

- Beam alignment for a scanning electron microscope (in collaboration, US patent awarded), that allowed for a total automation of the procedure. The full automation of the procedure eliminated operator-related subjectivity built in a manual process, saved time and increased precision.
- Astigmatism correction for scanning electron microscope that allowed for a total automation of the procedure. The method decreased the procedure time and improved repeatability of the tool.
- A suite of focusing algorithms. Developed a classification of types of substrates and images on customers' wafers requiring different focusing routines, enabled the tool to focus on many previously unworkable wafers and greatly improved precision (up to 6 times) on these materials.
- An adaptive algorithm for registration measurements (see MICRO: Defect/Yield Metrology - Schramm (October 2000) and SPIE Proceedings Vol. 3677) that responded to a partial loss of symmetry in shallow trench isolation structures.
- Several image enhancement algorithms (similar to "unsharp" mask, but fine-tuned for semiconductor structures and images).
- New measurement for metrology of ellipses for thin-film head industry.
- An adaptive critical dimension measurement capable of highly precise detection of the bottom of a substrate. (Currently under application for a US patent)
- Applied that method to find bottom of the holes on features on wafers for thin-film head industry.

#### **Parametric Technology Corporation, Waltham, MA 1996 to 1997**

**Software Engineer.**

**Developed software for geometric solutions for Pro/E CAD/CAM. Worked in C/C++.**

- Analyzed, designed and implemented a restriction of the tool path for milling work sequences to a workpiece.
- Designed and implemented several new user options for milling tool sequences and their outputs.
- Analyzed and implemented new zoning algorithm for face milling. The new zoning was more economical in terms of tool's lifetime (when a tool goes through the surface of the workpiece (inside and outside of it) the changes in tension it experiences shorten its lifetime).

#### **Ohio State University Department of Mathematics, Columbus, OH**

**1991 to 1996**

**Teaching Associate and PhD student. Conducted research and Programming**

- Model dynamical processes as part of the research project on the Focker-Plank equation
- Programming (design and engineering) to assist a class taught on object-oriented technique. C/C++.
- Singularities of differential equations.
- Non-commutative geometry.
- Applications of differential equations to percolation theory of metal engineering and to impedance problems in geophysics and geology.

### ***Some Recent publications:***

- [SPIE2015] V. V. Yashchuk, Yu. N. Tyurin, and A. Yu. Tyurina, "Modeling of surface metrology of state-of-the-art x-ray mirrors as a result of stochastic polishing process," Proc. SPIE 9809, 98090M/1-16 (2015); doi:10.1117/12.2218750 1-16.
- [OptEng2014] Yashchuk, V. V., Tyurin, Y. N., and Tyurina, A. Y., "Application of the time-invariant linear filter approximation to parametrization of surface metrology with high-quality x-ray optics," Opt. Eng. 53(8), 084102 (2014).
- [SPIE2013] Yashchuk, V. V., Tyurin, Y. N., and Tyurina, A. Y., "Application of time-invariant linear filter approximation to parameterization of one- and two-dimensional surface metrology with high quality x-ray optics," Proc. SPIE 8848, 88480H-1-13 (2013).
- [OptEng2012-1] Y. V. Yashchuk and V. V. Yashchuk, "Reliable before-fabrication forecasting of expected surface slope distributions for x-ray optics," Opt. Eng. 51(4), 046501 (2012) [<http://dx.doi.org/10.1117/1.OE.51.4.046501>].
- [SPIE12-2] with R Narayanaswami, D Diel, RK Mehra, and JM. Chinn 'Investigation of kinematic features for dismount detection and tracking.' Proc. SPIE, (2012)
- [SPIE2011-1] Yashchuk, Y. V. and Yashchuk, V. V., "Reliable before-fabrication forecasting of expected surface slope distributions for x-ray optics," Proc. SPIE 8141, 81410N-1-15 (2011).
- [SPIE2011-2] with AR Narayanaswami, D Diel, and R K. Mehra, and JM. Chinn 'Discrimination and classification of moving objects.'
- [Science2008] with Timothy D. Harris, Phillip R. Buzby, Hazen Babcock, Eric Beer, Jayson Bowers, Ido Braslavsky, Marie Causey, Jennifer Colonell, James DiMeo, J. William Efcavitch, Eldar Giladi, Jaime Gill, John Healy, Mirna Jarosz, Dan Lapen, Keith Moulton, Stephen R. Quake, Kathleen Steinmann, Edward Thayer, Rebecca Ward, Howard Weiss, Zheng Xie, "Single Molecule DNA Sequencing of a Viral Genome", Science, April 4, 2008, Vol. 320 pp. 106-109

### ***Relevant patents:***

1. Point source detection, Patent number: 8831316
2. Image analysis, Application number: 20070177799
3. Beam alignment of a scanning electron microscope, Patent number: 6717143

### ***Education***

- **1991 to 1996** Mathematics Graduate Program at the Ohio State University, all but thesis PhD.
- **Took all core classes for Master program at Software department.**
- **1986** MS in Math with honor from Moscow State University. On the dean's list yearly and received honor fellowships.
- Winner of Moscow City Math competitions for High School Students and University Students.