

# REPORT DOCUMENTATION PAGE

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6. AUTHORS Alex Figotin Department of Mathematics University of California at Irvine				
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13. ABSTRACT (Maximum 200 words)  Research Training will include: <ul style="list-style-type: none"> <li>The studies of classical electromagnetism and electrodynamics in inhomogeneous media</li> <li>Studies of variational and finite element methods as well as other modern numerical techniques for computation of the spectral attributes of inhomogeneous dielectric media crucial for the EM waves propagation.</li> <li>Participation in my ongoing research on the spectral properties of 2D and 3D photonic crystals, localized EM eigenmodes generated by defects in photonic crystals, tunable 2D photonic crystals and optimal design of photonic crystals based on our studies.</li> </ul>				
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## FINAL REPORT

AFOSR Contract No. F49620-97-1-0488, AASERT.

“Properties of Photonic Crystals”.

PI Alexander Figotin

Department of Mathematics  
University of California at Irvine

**Student N. Vrettos have been selected to work on the following objectives:**

1. Taking courses in mathematics and physics relevant to the research on the propagation of electromagnetic wave in inhomogeneous media.
2. Independent studies of linear algebra and spectral theory needed for the future work based on the finite-element method.
3. Investigation of the software on the finite-element method which can be adopted for the spectral analysis of photonic crystals.
4. Participation in our seminar on photonic crystals.

**Those objective have been successfully fulfilled as follows.**

### **1. Report of student N. Vrettos on his studies and taken courses.**

Fall, 1997 Semester:

#### EEGR 5090 - ACOUSTICS

This class focused on acoustic principles, and culminated in the presentation of a class project on an acoustic topic. I chose to examine the current state of knowledge regarding Sonoluminescence.

#### PHYS 5211 - MODERN OPTICS

This class concentrated on lasers, solid state lasers, LED's, and single and multi-mode optic fiber. I presented a lecture on Brillouin scattering as my class project.

#### MATH 6171 - ADVANCED ENGINEERING MATH

This class covered series solutions to differential equations, vector calculus and second order systems modeling.

Spring, 1998 Semester

### EEGR 6000 - RADIATION DETECTORS

This class covered traditional radiation detection, and the principles behind solid state radiation detection devices. We are currently attempting to build Silicon Nitride detectors.

### EEGR 6118 - DIGITAL IMAGE PROCESSING

This class covers image processing techniques in the spatial and frequency domains and image segmenting. All class projects are written in C++.

### EEGR 6127 - MEDICAL ULTRASOUND

This class is a continuation of EEGR 5090. We expanded our knowledge of acoustics by looking at ultrasonic transducers. We study how they work, their equivalent electrical circuits and the different types of scanning modes. We also did literature searches and wrote papers on topics our professor assigned to us.

### MEGR 5090 - BIOTECHNOLOGY AND BIOENGINEERING

This class studies the major topics in biotech and bioengineering. We are expected to research a biotech/bioengineering topic and submit a paper and presentation of that topic.

**2. Student Vrettos studied in detail basics of linear algebra and the spectral theory for finite matrices.**

**3. Student Vrettos actively searched software we can adopt for the spectral analysis of photonic crystals. He found and explored the possibility of using the "FELISA" program (NASA) for our spectral analysis.**

**4. Student Vrettos attended our seminar on seminar on photonic crystals which included my lectures on the cavity states for photonic crystals with defects and lectures of Prof. A. Babin of nonlinear problems which can be useful for photonic crystals with nonlinearities.**

#### **5. Summary of accomplishments:**

1. N. Vrettos took important for his general education courses in physics including: modern optics, acoustics, digital processing and more; and the advanced course in engineering mathematics which covers differential equations and vector calculus.
2. N. Vrettos studied in detail the basics of the linear algebra and the spectral theory for finite matrices needed for the future work using finite-element method.



Alex Figotin