NSF GUIDELINES FOR INTELLECTUAL MERIT STATEMENT

The Intellectual Merit criterion encompasses the potential to advance knowledge.

The following elements should be considered in the review for this criterion:

1. What is the potential for the proposed activity to advance knowledge and understanding within its own field or across different fields?

2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?

3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?

4. How well qualified is the individual, team, or organization to conduct the proposed activities?

5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

EXAMPLES
INTELLECTUAL MERIT STATEMENT

#1
The research results complement the current design guidelines and lead to sound design methods for anchors in seismic applications. Particularly, this research clarifies the current capacity design philosophy, redefines the definition of ductile failure modes, and evaluates the interaction equation for anchors under cyclic tension-shear. The research also explores the possibility of extending the existing design equations to the anchors embedded in concrete members that may experience significant damage. With the fundamental knowledge on single anchor behavior under seismic load, two typical anchor connections, which have been used in practice without justification, will be experimentally evaluated, and reliable connection details, if necessary, will be developed and verified. Specifically, suggestions on effective ways of using supplemental reinforcement to improve the capacity and ductility of anchor connections will be proposed and design guidelines along with examples will be created for engineers. With the improved knowledge and details, engineers will be able to design safe anchor connections confidently for seismic applications.

#2
The control of light propagation by 3D-microstructured optical fibers and temporal index modulation offers novel opportunities to substantially modify the confinement, guiding, dispersive, and nonlinear properties of fibers. Optical fibers have been the backbone of much scientific and technological advancement in past decades. Many novel ideas in photonics as well as in other fields of science can best be explored in the robust platform of optical fibers due to their controllable transverse confinement and low-loss propagation of light. The proposed novel microstructured optical fibers will expand the horizons for such novel explorations. Multimode fibers provide a very interesting and complex system where the interactions between the nonlinearity, mode-coupling, and microstructured index profiles are largely unexplored and will be studied here.

The proposed CAREER program will build on the PI's prior experience on fiber optic-related research at OSC in Arizona, Corning Inc., and more recently at UWM. The PI has successfully employed powerful theoretical techniques to study the impact of the underlying lattice shape on various physical attributes of photonic crystal fibers. This work uncovered novel phenomena, cleared up some misconceptions in the literature, and was the first step in a systematic quest to uncover the novel attributes of 3D- and temporal-microstructured fibers, using theory and experiment.

#3
This research tackles the outstanding problem of desalination for drinking water production from a completely new standpoint, contributing to our understanding of bio-electrochemical desalination by discovering new knowledge of microbiological, physical, chemical, and electrochemical interactions during the desalination process. This contribution is significant because scaling-up the developed MDC systems will transform desalination from an energy-consuming process to an energy-producing process. This research will be the first systematic study to focus on integrating wastewater treatment and desalination in a single bioreactor and to investigate how reactor configuration and bio-electrochemical reactions will affect desalination. It will provide valuable information and experience for future design and operation of MDC systems, and help us to understand the limiting factors on system performance. Microbial analysis will generate knowledge of organisms that can tolerate high salinity while contributing to electricity generation. The success of this research will have the potential to revolutionize desalination technology.