**Distortion, Deterioration and Failure: Foundations of Refined Design and Manufacture**

It is said that scientists discover the material and engineers discover new ways to use it. This brief sentence summarizes the importance of understanding the material for design development. Moreover, it is known that operating conditions and environment affect structural performance and life. This highlights the importance of understanding these effects to develop enhanced designs. For example, titanium is preferred in turbines of jet engines for apparently different reasons than those resulting in being preferred for medical implants. Meanwhile, studying titanium in the atomistic and molecular scale explains common reasons to for its superior performance in both environments, i.e. extreme temperature and immune system. These particular aspects entail studying material performance in its service environment hence dictate the need to perform multiscale analyses. However, multiscale simulations, e.g. chemothermomechanical, present severe challenges for the designer in terms of cost and accuracy. Therefore, the presented work is based on unified foundation of utilizing different analysis tools to identify and enable promoting mechanical behavior across scales. Conclusive relationships are developed to accurately describe material degradation and its effects on failure limits. In turn degradation and failure limits are used to develop design tools, e.g. through establishing failure maps of a structure. Examples are presented to demonstrate applicability of this unified foundation in various engineering fields, namely, space applications, aircraft structures, oil and gas pipelines, ship superstructure and biomedical applications.

Dr. Nakhla is Associate Professor in Mechanical Engineering, Faculty of Engineering Applied Science and cross-appointed to Emergency Medicine, Faculty of Medicine at Memorial University of Newfoundland. He earned both his MSc and PhD from the School of Aerospace Engineering at Georgia Institute of Technology in 2004 and 2008, respectively. His research interests span failure prediction and remaining life of engineering applications in aerospace, mechanical and biomedical engineering. His research in these areas is funded by Natural Sciences and Engineering Research Council (NSERC), Suncor Energy, Bombardier, Research & Development Corporation (RDC; currently InnovateNL) and the Faculty of Engineering and Applied Science at Memorial University. Prior to joining Memorial in 2013, he was a Post-Doctoral Fellow then Research Engineer in the School of Aerospace Engineering at Georgia Institute of Technology (2008-2012). His research while at Georgia Institute of Technology was funded by National Aeronautics and Space Administration (NASA), US Office of Naval Research (ONR) and Dassault Systèmes.

Dr. Nakhla is registered as ‘Aerospace Engineer’ with Professional Engineers and Geoscientists Newfoundland & Labrador (PEGNL).