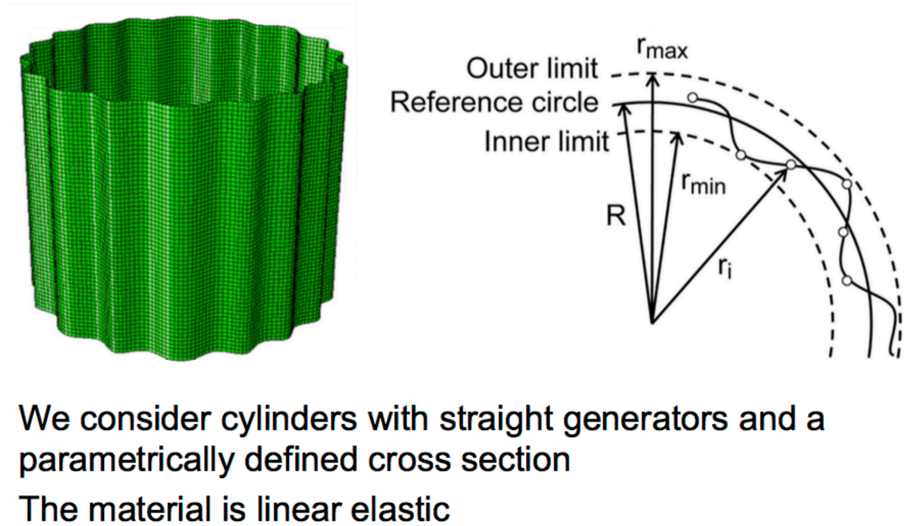
Dr. Xin Ning



From: “Buckling of cylindrical shells: Avoidance of imperfection sensitivity through shape optimization”, by Xin Ning and Sergio Pellegrino, Int. J. Solids Struct, 2015

See:
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Selected Publications:

Ning, X., and Pellegrino, S. (California Institute of Technology, Pasadena, CA 91225), (2012). “Design of lightweight structural components for direct digital manufacturing”. 53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 23-26 April 2012 Honolulu, Hawaii.
ABSTRACT: The rapid growth in direct digital manufacturing technologies has opened the challenge of designing optimal micro-structures for high-performance components. Current topology optimization techniques do not work well for this type of problems and hence in this paper we propose a technique based on an implicit representation of the structural topology. The detailed microstructure is designed by a continuous variable, the size distribution field, defined over the design domain by chosen shape functions. We can optimize the structural topology by optimizing only the weights of the size distribution and, for any given size distribution, we use standard meshing software to determine the actual detailed micrstructure. We have implemented the optimization loop using commercial CAD and FEA software, running under a genetic algorithm in MATLAB. Application this novel technique to the design of a sandwich beam has produced designs that are superior to any standard solid beam or even optimized truss structure.

Xin Ning and Sergio Pellegrino (California Institute of Technology, Pasadena, CA 91125), “Buckling Analysis of Axially Loaded Corrugated Cylindrical Shells”. AIAA ??th Structures, Structural Dynamics and Materials Meeting, (year not given in the pdf file. The most recent reference is 2014.)

ABSTRACT: Buckling analyses of heavily corrugated cylindrical shells based on detailed full finite element models are usually computationally expensive. To address this issue, we have proposed an efficient computational method of predicting the onset of buckling for corrugated cylindrical shells which builds on the Bloch wave method for infinitely periodic structures. We modified the traditional Bloch wave method in order to analyze the buckling of rotationally periodic shell structures. We have developed an efficient algorithm to perform our modified Bloch wave method. The buckling behavior of composite corrugated cylindrical shells with a range of numbers of corrugations was analyzed. Linear and nonlinear buckling analyses of detailed full finite element models were also performed and compared to our method. Comparisons showed that our modified Bloch wave method was able to obtain highly accurate buckling loads and it was able to capture both global and local buckling modes. It was also found that the computational time required by our modified Bloch wave method did not scale up as the number of corrugations increased.

Xin Ning and Sergio Pellegrino (California Institute of Technology, Pasadena, CA 91125), "Imperfection-Insensitive Axially Loaded Cylindrical Shells", AIAA Paper No. (not given), AIAA, 54th AIAA Structures, Structural Dynamics and Materials meeting in Boston, Massachusetts, April 2013). See also, International Journal of Solids and Structures, xxx (2015) xxx-xxx (13 pages, in press): Proper citation is as follows:
Ning, X., Pellegrino, S. Imperfection-insensitive axially loaded thin cylindrical shells. Int. J. Solids Struct. (2015), http:// dx.doi.org/10.1016/j.ijsolstr.2014.12.030

ABSTRACT: The high efficiency of monocoque cylindrical shells in carrying axial loads is curtailed by their extreme sensitivity to imperfections. For practical applications, this issue has been alleviated by introducing closely stiffened shells which, however, require expensive manu- facturing. Here we present an alternative approach that provides a fundamentally different solution. We design symmetry-breaking wavy cylindrical shells that avoid imperfection sen- sitivity. Their cross-section is formulated by NURBS interpolation on control points whose positions are optimized by evolutionary algorithms. We have applied our approach to both isotropic and orthotropic shells and have also constructed optimized composite wavy shells and measured their imperfections and experimental buckling loads. Through these experi- ments we have confirmed that optimally designed wavy shells are imperfection-insensitive. We have studied the mass efficiency of these new shells and found them to be more efficient than even a perfect circular cylindrical shell and most stiffened cylindrical shells.