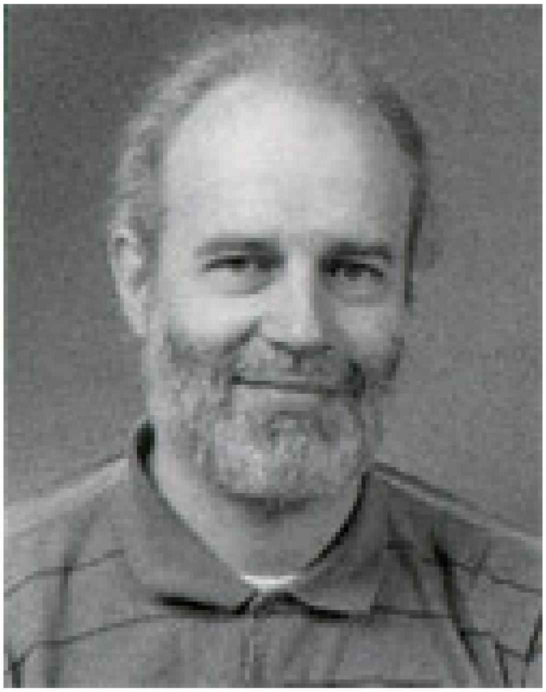

Professor Emeritus Joseph Padovan

http://65.54.113.26/Author/12855807/joseph-padovan

Education:
B.S. (Mechanical Engineering), Polytechnic Institute of Brooklyn, 1965.
M.S. (Mechanical Engineering), Polytechnic Institute of Brooklyn, 1967.
Ph.D. (Mechanical Engineering), Polytechnic Institute of Brooklyn, 1969.

Experience:
Professor, Department of Mechanical Engineering and Polymer Engineering, The University of Akron, 1979-present.
Associate professor, Department of Mechanical Engineering, The University of Akron, 1974-79.
Assistant professor, Department of Mechanical Engineering, The University of Akron, 1970-74.
Experience in aerospace, tire, rubber, automotive, bearing and chemical-steel industries, as well as government agencies, NASA, the U.S. Navy, and U.S. Air Force.

Professional and Honorary Societies:
Member: ASME and Tire Society of America.

Honors and Awards:
University Researcher of the Year, 1986.
A.T. Colwell Merit Award-Society of Automotive Engineers, 1988.
Certificate of Recognition, NASA, 1988.
Best Paper Award, Tire Society, 1990.
College of Engineering, Researcher of the Year, 1991.

Research and Professional Activities:
Analvtical and computational nonlinear continuum mechanics, applied stress, finite element analysis, tire mechanics, applied mathematics, heat transfer, and polymer materials.
Reviewer for numerous technical journals, government agencies, corporations.
Presented numerous professional seminars for industry both in the U.S. and abroad.
Consultant to aerospace, tire, automotive, and chemical/steel industries.

Selected Publications:

Joseph Padovan (Mechanical Engineering, University of Akron, 302 E Buchtel Avenue, Akron, Ohio 44304 USA), "Frequency and buckling eigenvalues of anisotropic cylinders subjected to nonuniform lateral prestress", International Journal of Solids and Structures, Vol. 7, No. 11, November 1971, pp. 1449-1466, doi:10.1016/0020-7683(71)90029-1
ABSTRACT: Solutions are developed herein for the evaluation of frequency and stability eigenvalues of macro-scopically fully anisotropic circular cylindrical shells subjected to nonuniform lateral prestress. Included in the analysis is the presence of torsional prestress. The results obtained are applicable to any type of prestress which satisfy Dirichlet's conditions for Fourier series. Furthermore, in the manner of Kalnins [3], using the procedure outlined herein, similar results could be obtained for general anisotropic shells of revolution.

Joseph Lestingi and Joseph Padovan (College of Engineering, The University of Akron, Akron, Ohio 44325, U.S.A), "Numerical analysis of anisotropic rotational shells subjected to nonsymmetric loads", Computers & Structures, Vol. 3, No. 1, January 1973, pp. 133-147, doi:10.1016/0045-7949(73)90079-5
ABSTRACT: Through the use of an integral transform, the present paper extends the applicability of the multisegment numerical integration technique to include the solution of general macroscopically anisotropic multilayered shells of revolution. It is found that compared with orthotropic shells, material anisotropy induces a doubling in the number of transformed fundamental equations characterizing the static response. Employing the transform together with the multisegment integration technique and several concepts from the direct stiffness method of structural analysis, procedures are developed which can handle branched anisotropic multilayered shells of revolution in a more effective manner than was previously possible. Based on the procedures outlined in the paper, numerical studies are presented which show the effect of segment size on the solution accuracy and the effects of material anisotropy on selected shell configurations.

Joseph Padovan and Joseph F. Lestingi (The University of Akron, Akron, Ohio 44325, U.S.A.), "Complex numerical integration procedure for static loading of anisotropic shells of revolution", Computers & Structures, Vol. 4, No. 6, December 1974, pp. 1159-1172, doi:10.1016/0045-7949(74)90030-3
ABSTRACT: Through the use of a complex series representation, a complex multi-segment numerical integration procedure is developed which can handle the static analysis of mechanically and thermally loaded branched laminated anisotropic shells of revolution with arbitrary meridional variations in thickness and material properties. In contrast to the real numerical integration treatment of anisotropic shells, the present procedure develops local and global stiffness matrices which require only half the computer storage and which requires significantly less overall computer time. Furthermore, since the overall procedure requires fewer computational steps, an improvement in numerical resolution is also obtained for a given word size machine. To illustrate the procedure several numerical examples are included.

Joseph Padovan (University of Akron, Akron, Ohio 44325, U.S.A), “Computers & Structures, Vol. 4, No. 3, May 1974, pp. 467-483, doi:10.1016/0045-7949(74)90001-7
ABSTRACT: Using complex series representations, a quasi-analytical finite element procedure is developed which can analyze the static and dynamic mechanical fields of anisotropic axisymmetric shells and bodies. Due to its generality the procedure can handle arbitrary laminate construction with possible meridional and radial variations in locally or globally mechanically anisotropic materials. In this respect, in contrast to traditional quasi-analytical procedures which are limited to the ‘specially’ orthotropic case, the present treatment reveals several important effects of material and/or structural anisotropy. To illustrate the procedure as well as the significant effects of material anisotropy, several numerical examples are given along with comparisons with known analytical treatments.

Joseph Padovan (University of Akron, Akron, OH 44325, U.S.A.), “Numerical analysis of asymmetric frequency and buckling eigenvalues of prestressed rotating anisotropic shells of revolution”, Computers & Structures, Vol. 5, Nos. 2-3, June 1975, pp. 145-154, doi:10.1016/0045-7949(75)90004-8
ABSTRACT: A numerical integration procedure is developed which can obtain the frequency and buckling eigenvalues and associated eigenfunctions of prestressed rotating anisotropic shells of revolution. The axisymmetric prestress state incorporated in the analysis can consist of torque as well as anisotropy induced circumferential effects. Apart from the usual centripetal load, the rotation effects treated by the analysis also consist of Coriolis acceleration forces. The material and/or structural anisotropy included in the analysis is of the most general linear Hookean form. Hence, the stiffness matrix of the governing shell constitutive relation can be fully populated. To illustrate the numerical procedure as well as the significant effects of general axisymmetric prestress states (including torsion), Coriolis acceleration forces and material and/or structural anisotropy, several numerical experiments are given along with comparisons with analytical treatments.

Joseph Padovan (University of Akron, Akron, OH 44325, U.S.A.), “Traveling waves vibrations and buckling of rotating anisotropic shells of revolution by finite elements”, International Journal of Solids and Structures, Vol. 11, No. 12, December 1975, pp. 1367-1380, doi:10.1016/0020-7683(75)90064-5
ABSTRACT: A quasi-analytical finite element procedure is developed which can obtain the frequency and buckling eigenvalues of prestressed rotating anisotropic shells of revolution. In addition to the usual centrifugal forces, the rotation effects treated also include the contribution of Coriolis forces. Furthermore, since a nonlinear version of Novozhilov's shell theory is employed to develop the element formulation, the effects of moderately large prestress deflection states can be handled. Due to the generality of solution procedure developed, the axisymmetric prestress states treated can also consist of torque loads. In order to illustrate the procedures capabilities, as well as the significant effects of Coriolis forces, torque prestress and material anisotropy, several numerical experiments are presented.

J. Padovan (Department of Mechanical Engineering, University of Akron, Akron, Ohio 44325, U.S.A.), “Non-linear vibrations of general structures”, Journal of Sound and Vibration, Vol. 72, No. 4, October 1980, pp. 427-441, doi:10.1016/0022-460X(80)90355-7
ABSTRACT: Based on the finite element and perturbation procedures, an analytical-numerical approach to non-linear vibrations is developed. In particular, the overall solution employs the finite element method to handle spatial dependencies while the constrained version of the perturbation procedure is used to treat the temporal behavior. Due to the generality of the method developed, any combination of structure and boundary restraints can be treated as well as the possibility of conservative and non-conservative situations wherein the system can have any number of frequency branches. Furthermore, the procedure is not restricted to excitations in the neighborhood of specific frequencies, but rather applies to the full range. To demonstrate the capabilities

of the solution approach, the results of several numerical studies are included along with experimental verification.

Joseph Padovan (The University of Akron, Akron, OH 44325, U.S.A.), "Spectral/critical speed characteristics of structure subject to moving loads", International Journal of Engineering Science, Vol. 20, No. 1, 1982, pp. 77-91, doi:10.1016/0020-7225(82)90074-X
ABSTRACT: Through the use of a family of generalized Rayleigh quotients, this paper considers the influence of nonstationary time dependent loads/disturbances on the spectral characteristics of structure modeled by 3-D nonpolar elasticity theory wherein the fields are treated as small excursions superposed on large. To generalize the results, the influence of nonconservatism and generalized inertia fields are admitted. The main emphasis of the work is given to determining the various properties of the eigevalue problem arising out of such nonstationary loading situations. This includes ascertaining the occurrence of various types of spectral/critical speed shifts /bifurcations induced by moving disturbances. As a further extension of the work, the results are specialized to the eignevalue problem arising from nonconservative gyroscopic FE simulations of moving load problems.

Joseph Padovan and Surapong Tovichakchaikul (Department of Mechanical Engineering, The University of Akron, Akron, OH 44325, U.S.A.), "On the solution of creep induced buckling in general structure", Computers & Structures, Vol. 15, No. 4, 1982, pp. 379-392, doi:10.1016/0045-7949(82)90072-4
ABSTRACT: This paper considers the pre and post buckling behavior of general structures exposed to high temperature fields for long durations wherein creep effects become significant. The solution to this problem is made possible through the use of closed upper bounding constraint surfaces which enable the development of a new time stepping algorithm. This permits the stable and efficient solution of structural problems which exhibit indefinite tangent properties. Due to the manner of constraining/bounding successive iterates, the algorithm developed herein is largely self adaptive, inherently stable, sufficiently flexible to handle geometric material and boundary induced nonlinearity, and can be incorporated into either finite element or difference simulations. To illustrate the capability of the procedure, as well as, the physics of creep induced pre and post buckling behavior, the results of several numerical experiments are included.

Joseph Padovan and Surapong Tovichakchaikul (The University of Akron, Akron, OH 44325, U.S.A.), "Self-adaptive predictor-corrector algorithms for static nonlinear structural analysis", Computers & Structures, Vol.15, No. 4, 1982, pp. 365-377, doi:10.1016/0045-7949(82)90071-2
ABSTRACT: This paper develops a multi phase self-adaptive predictor corrector type algorithm to enable the solution of highly nonlinear structural responses including kinematic, kinetic and material effects as well as potential pre/postbuckling behavior. The hierarchy of the strategy is such that three main phases are involved. The first features the use of a warpable hyperelliptic constraint surface which serves to upperbound dependent iterate excursions during successive INR type iterations. The second corrector phase uses an energy constraint to scale the generation of successive iterates so as to maintain the appropriate form of local convergence behavior. The third involves the use of quality of convergence checks which enable various self-adaptive modifications of the algorithmic structure when necessary. Such restructuring is achieved by tightening various conditioning parameters as well as switch to different algorithmic levels so as to improve the convergence process. Included in the paper are several numerical experiments which illustrate the capabilities of the procedure to handle varying types of nonlinear structural behavior.

Joseph Padovan (1) and Surapong Tovichakchaikul and Ibrahim Zeid (2)
(1) Department of Mechanical Engineering, University of Akron, Akron, OH443-4, U.S.A.

(2) Department of Mechanical Engineering, North Eastern University, Boston, MA 02115, U.S.A. "Finite element analysis of steadily moving contact fields", Computers & Structures, Vol. 18, No. 2, 1984, pp. 191-200, doi:10.1016/0045-7949(84)90119-6
ABSTRACT: By introducing a moving updated Lagrangian observer, this paper develops traveling finite elements with the capacity to handle the global response resulting from steadily moving contact fields. The generality of the results is such that large deformation kinematics and kinetics as well as the full compliment of inertial fields can be handled. To streamline the handling of nonlinear behavior, an elliptically constrained solution algorithm is also developed. Employing this algorithm, the results of several numerical benchmarking studies are presented which illustrate the capacity of the moving updated Lagrangian formulation as well as the potential effects of nonlinearity.

Joseph Padovan (Department of Mechanical Engineering, University of Akron, 302 E. Buchtel Avenue, Akron, OH 44325, U.S.A.), "Solving postbuckling collapse of structures", Finite Elements in Analysis and Design, Vol. 1, No. 4, December 1985, pp. 363-385, doi:10.1016/0168-874X(85)90032-0
ABSTRACT: This paper overviews the current state of solution schemes used to solve pre- and postbuckling problems. Main emphasis will be given to (i) defining the generic features of buckling, (ii) outline the shortcomings associated with classical incremental Newton-Raphson type schemes, (iii) introducing the constrained incremental Newton-Raphson methodology, (iv) review capacities of various currently available general purpose codes, and (v) point out several areas of further investigation.

Joe Padovan and Ralph Moscarello (University of Akron, Akron, OH 44325, U.S.A.), "Locally bound constrained Newton-Raphson solution algorithms", Computers & Structures, Vol. 23, No. 2, 1986, pp. 181-197, doi:10.1016/0045-7949(86)90211-7
ABSTRACT: This paper develops strategies which enable the automatic adjustment of the constraint surfaces recently used to extend the range and numerical stability/efficiency of nonlinear finite-element equation solvers. In addition to handling kinematic and material induced nonlinearity. both pre- and postbuckling behavior can be treated. The scheme developed employs localized bounds on various hierarchial partitions of the field variables. These are used to resize, shape, and orient the global constraint surface, thereby enabling essentially automatic load/deflection incrementation. Due to the generality of the approach taken, it can be implemented in conjunction with constraints of arbitrary functional type. To benchmark the method, several numerical experiments are presented. These include problems involving kinematic and material nonlinearity. as well as. pre- and postbuckling characteristics.

Joe Padovan (Departments of Mechanical and Polymer Engineering, University of Akron, Akron, OH 44325, U.S.A.), "Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure—I. Theory", Computers & Structures, Vol. 27, No. 2, 1987, pp. 249-257, doi:10.1016/0045-7949(87)90093-9
ABSTRACT: In a three-part series of papers, a generalized finite element analysis scheme is developed to handle the steady and transient response of moving/rolling nonlinear viscoelastic structure. This paper considers the development of the moving/rolling element strategy, including the effects of large deformation kinematics and viscoelasticity modeled by fractional integrodifferential operators. To improve the solution strategy, a special hierarchical constraint procedure is developed for the case of steady rolling/translating as well as a transient scheme involving the use of a Grunwaldian representation of the fractional operator. In the second and third papers [R. Kennedy and J. Padovan, Comput. Struct.27, 259–273 (1987) and Y. Nakajima and J. Padovan, Comput. Struct.27, 275–286 (1987)], 3-D extensions are developed along with transient contact strategies enabling the handling of impacts with obstructions. Overall the various developments are benchmarked via

comprehensive 2- and 3-D simulations. These are correlated with experimental data to define modeling capabilities.

Ronald Kennedy and Joe Padovan (Departments of Mechanical and Polymer Engineering, University of Akron, Akron, OH 44325, U.S.A.), "Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure—II. Shell and three-dimensional simulations", Computers & Structures, Vol. 27, No. 2, 1987, pp. 259-273, doi:10.1016/0045-7949(87)90094-0
ABSTRACT: In a three-part series of papers, a generalized finite element solution strategy is developed to handle traveling load problems in rolling, moving and rotating structure. The main thrust of this section consists of the development of 3-D and shell type moving elements. In conjunction with this work, a compatible 3-D contact strategy is also developed. Based on these modeling capabilities, extensive analytical and experimental benchmarking is presented. Such testing includes traveling loads in rotating structure as well as low- and high-speed rolling contact involving standing wave-type response behavior. These point to the excellent modeling capabilities of moving element strategies.

Nakajima Yukio and Joe Padovan (Departments of Mechanical and Polymer Engineering, University of Akron, Akron, OH 44325, U.S.A.), "Finite element analysis of steady and transiently moving/rolling nonlinear viscoelastic structure—III. Impact/contact simulations", Computers & Structures, Vol. 27, No. 2, 1987, pp. 275-286, doi:10.1016/0045-7949(87)90095-2
ABSTRACT: In a three-part series of papers, a generalized finite element methodolgy is formulated to handle traveling load problems involving large deformation fields in structure composed of viscoelastic media. The main thrust of this paper is to develop an overall finite element methodology and associated solution algorithms to handle the transient aspects of moving problems involving contact impact type loading fields. Based on the methodology and algorithms formulated, several numerical experiments are considered. These include the rolling/sliding impact of tires with road obstructions.

Joseph Padovan and Amir Kazempour (Departments of Mechanical and Polymer Engineering, The University of Akron, Akron, Ohio 44325, U.S.A.), "Multibody instantly centered moving lagrangian observer schemes—Part I. Formulation", Computers & Structures, Vol. 32, No. 1, 1989, pp. 93-100,
ABSTRACT: Employing an instantly centered moving Lagrangian observer (ICMLO), this two part series of papers develops a finite element (FE) modeling methodology which can handle multibody problems involving several rotating components each with its own distinct rotational history. The overall thrust of the work is to enable the modeling of mechanical systems as opposed to purely structural problems. This includes the ability to simulate rotating equipment, transportation systems, aircraft frame-engine interactions, i.e. complete machinery responses. In this part, emphasis is given to (i) establishing the ICMLO, (ii) developing the FE formulation, and (iii) deriving the associated steady and transient solution algorithms. In Part II, extensive modifications are introduced to handle automotive type vehicular models. To demonstrate the scheme, simulations involving vehicular-obstruction rollover events are presented.

Amir Kazempour and Joseph Padovan (Departments of Mechanical and Polymer Engineering, The University of Akron, Akron, Ohio 44325, U.S.A.), "Multibody instantly centered moving lagrangian observer schemes—Part II. Application to vehicular simulations", Computers & Structures, Vol. 32, No. 1, 1989, pp. 101-111, doi:10.1016/0045-7949(89)90074-6
ABSTRACT: Employing an instantly centered moving Lagrangian observer (ICMLO), this two part series develops a finite element scheme and associated solution algorithms which can handle the modeling of machinery involving a variety of rotating components each with its own distinct rotational history. In this part,

the methodology is extended to handle the steady and transient response of ground based automotive type vehicular systems. This includes the modeling of roadway-multiple tire-suspension-vehicular structural interactions during (i) steady rolling; (ii) obstacle envelopment, as well as; (iii) motion on generalized trajectories. In particular, the simulation accounts for such aspects as (i) contact impact; (ii) rolling friction; (ii) potential liftoff, free motion and recontact during obstacle envelopment. To illustrate the scheme, a full vehicular simulation is presented.

J. Padovan (2) and A. Kwang (1)
(1) Department of Mechanical Engineering, The University of Akron, Akron, OH 44325-3903, U.S.A.
(2) Departments of Mechanical and Polymer Engineering, The University of Akron, Akron, OH 44325-3903, U.S.A.
"Hierarchically parallelized constrained nonlinear solvers with automated substructuring", Computers & Structures, Vol. 41, No. 1, 1991, pp. 7-33, doi:10.1016/0045-7949(91)90152-C
ABSTRACT: This paper develops a parallelizable multilevel multiple constrained nonlinear equation solver. The substructuring process is automated to yield appropriately balanced partitioning of each succeeding level. Due to the generality of the procedure, both sequential, partially and fully parallel environments can be handled. This includes both single and multiprocessor assignment per individual partition. Several benchmark examples are presented. These illustrate the robustness of the procedure as well as its capacity to yield significant reductions in memory utilization and calculational effort due both to updating and inversion.