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This report describes research carried out by students under the above detailed AASERT award . The grant has been used to support two graduate students and two undergraduates (all American citizens as required by the term of the award.)

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Final Report

AFOSR AASERT #F49620-93-1-0323

This report describes research carried out by students supported under the above detailed AASERT award. The grant has been used to support two graduate students and two undergraduates (all American citizens as required by the terms of the award).

The first graduate student was Donald J. Dichmann. The award was used to support him during his final year of doctoral study. His thesis concerns the nonlinear dynamics of rods, and in particular the stability of loop solitary waves. After completeing his thesis he took up an Industrial Mathematics postdoc from the NSF (with Maddocks as PI and Computer Sciences Corporation and NASA as industrial sponsors), with the research objective of considering the effects of the dynamics of flexible aerials and antennas (modelled as rods) on the attitude dynamics of the satellite as a whole. That project is itself drawing to a close. It has involved application of the impetus-striction formulation of constrained dynamics to successfully model the attitude dynamics of satellites with extremely long flexible antennas, including numerical simulations that match real data better than the currently accepted models. This research was a natural continuation of Dichmann's thesis topic supported under this AASERT award, combined with prior research of Maddocks and co-workers (supported by AFOSR parent awards) on noncanonical Hamiltonian models of satellite attitude dynamics. The publications arising from this work have been detailed under the reports to the parent proposal.

The second graduate student was Randy C. Paffenroth. During the course of this award he was studying for and successfully completed his PhD written exams. Simultaneously he has been developing his research expertise in the area of high performance computation on work station farms involving steered computation based on interactive 3D visualization. The application area he has been focussing on has been multi-parameter continuation as it arises in continuum models of large macro-molecules such as alpha-helical proteins. This research and associated software development strongly impacts both the parent award and SBIRS awarded by the Air Force to Moldyn Inc. Paffenroth's dissertation research will be completed under the support of another AFOSR AASERT award with the topic being computations involving molecular mechanics, and in particular determination of the accuracy of continuum rod models of deformed macromolecules when compared against computational models carried out at the individual atomic level where deformations are governed by inter-atomic potentials.

The two undergraduates supported under this grant were Amy Peng, and Brian Michalowski. Peng worked during the summer of 1993 and was involved in using the continuation code AUTO in the computation of data in a model describing DNA supercoiling. This data was included in a forthcoming paper by Li and Maddocks. Peng went on

to graduate school in Statistics and is continuing her studies toward a PhD. Michalowski was involved in a project (with Maddocks and J.C. Alexander) concerning the computation of minimal distance trajectories for mobile robots. The presence of nonholonomic constraints that model idealized wheels means that for such robots the shortest accessible path cannot always be a straight line. An understanding of the geodesics for this problem is central to basic robotics questions such as the determination of the effective distance between a robot and an obstacle. An article describing this work is about to be submitted to Int J. Robotics Research. Michalowski went on to complete a MSc in Computer Science and is now working at Microsoft.