1145-65-578 **Jenna C. Guenther*** (guenthjc@dukes.jmu.edu) and **Morgan A. Wolf** (wolf2ma@dukes.jmu.edu). *An Adaptive, Highly Accurate and Efficient, Parker-Sochacki Algorithm for Numerical Solution to Large Scale Dynamical Systems.* Preliminary report.

For nonlinear systems of differential equations, an explicit adaptive procedure using a foundation of the Parker-Sochacki Method (PSM) produces better accuracy in less time with significantly fewer steps when contrasted with many standard adaptive algorithms that use a Runge-Kutta (RK) foundation. First, two simple PSM functions are developed, illustrating a class of functions that represent the backbone of a future PSM tool for the scientific community. At each step across the domain, combinations of these functions efficiently and recursively generate the coefficients of the Taylor polynomial of the solution to the ODE system. An adaptive stepping algorithm is derived which provides a simple way to either increase or decrease the order of the method during computation. PSM Adaptive is first developed theoretically and then demonstrated on several examples, including a 2 degree of freedom system related to missile defense. Results are compared against standard RK adaptive algorithms including 4th/5th order Dormand Prince, the algorithm which serves as the foundation of MATLAB's renowned ODE45 solver. It is noted in the 2 degree of freedom example that PSM Adaptive takes roughly two orders of magnitude fewer steps and runs an order of magnitude faster for similar accuracy. (Received September 10, 2018)