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Curve fitting 3-D experimental turbulent flows with the poor man's Navier–Stokes equation J.M. MCDONOUGH, University of Kentucky, T.C. MITCHELL, P. L. Dunbar High School, S.C.C.C. BAILEY, University of Kentucky — The 3-D poor man's Navier–Stokes (PMNS) equation is a discrete dynamical system (DDS) whose solutions retain much of the dynamical behavior of the partial differential equations from which it is derived, and yet is very easily executed—far faster than real time. We briefly outline derivation of this DDS and then discuss a general procedure for curve fitting DDSs to chaotic experimental data. This technique (first introduced by McDonough *et al., Appl. Comp. Math.* 1998 and later used by Yang *et al., AIAA J.* 2003 in a 2-D Navier–Stokes setting) employs a least-squares method to generate a global (long-time) fit of chaotic data that produces details of experimental time series in a manner more appropriate for representing fluid turbulence (including sensitivity to initial conditions) than often used short-time extrapolation techniques can. We apply this least-squares approach to three-component velocity measurements in grid turbulence described by Bailey and Tavoularis, *J. Fluid Mech.* 2008, and demonstrate that the PMNS equation can reproduce the structure of all three experimental velocity components. We present comparisons of time series, energy spectra, and other typical turbulence statistics, *e.g.*, flatness and skewness. A possible application of such curve fits would be to real-time control of physical turbulent fluid flows.

J. M. McDonough
University of Kentucky

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