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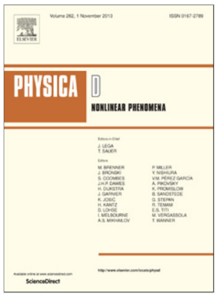

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Sergey A. Dyachenko, Anatoly Zlotnik, Alexander O. Korotkevich, Michael Chertkov

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Operator Splitting Method for Simulation of Dynamic Flows in Natural Gas Pipeline Networks

Sergey A. Dyachenko[a,b], Anatoly Zlotnik[c], Alexander O. Korotkevich[d,e,*], Michael Chertkov[f,g]

[a]*Department of Mathematics, University of Illinois Urbana-Champaign, 1409 W. Green Street, Urbana, IL 61801, USA;*
[b]*current address: ICERM, Brown University, Box 1995, Providence, RI 02912, USA*
[c]*Theoretical Division, T-5, Los Alamos National Laboratory, Los Alamos, NM 87545, USA*
[d]*Department of Mathematics & Statistics, The University of New Mexico, MSC01 1115, 1 University of New Mexico, Albuquerque, New Mexico, 87131-0001, USA*
[e]*L. D. Landau Institute for Theoretical Physics, 2 Kosygin Str., Moscow, 119334, Russia*
[f]*Theoretical Division, T-4 & CNLS, Los Alamos National Laboratory, Los Alamos, NM 87545, USA*
[g]*Energy System Center, Skoltech, Moscow, 143026, Russia.*

Abstract

We develop an operator splitting method to simulate flows of isothermal compressible natural gas over transmission pipelines. The method solves a system of nonlinear hyperbolic partial differential equations (PDEs) of hydrodynamic type for mass flow and pressure on a metric graph, where turbulent losses of momentum are modeled by phenomenological Darcy-Weisbach friction. Mass flow balance is maintained through the boundary conditions at the network nodes, where natural gas is injected or withdrawn from the system. Gas flow through the network is controlled by compressors boosting pressure at the inlet of the adjoint pipe. Our operator splitting numerical scheme is unconditionally stable and it is second order accurate in space and time. The scheme is explicit, and it is formulated to work with general networks with loops. We test the scheme over range of regimes and network configurations, also comparing its performance with performance of two other state of the art implicit schemes.

Keywords: pipeline simulation, operator splitting

1. Introduction

Economic and technological changes have driven an increase in natural gas usage for power generation, which has created new challenges for the operation of gas pipeline networks. Intermittent and varying gas-fired power plant activity produces fluctuations in withdrawals from natural gas pipelines, which today

*Alexander O. Korotkevich
Email address: alexkor@math.unm.edu (Alexander O. Korotkevich)