Shaping the chameleon

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Abstract

In conservation with Clare Burrage, Ed Copeland, James...

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1 Introduction

2 The model

The equations are

$$\nabla^2\phi = -\frac{\Lambda^5}{\phi^2} + \frac{\rho}{M}, \tag{2.1a}$$

$$\nabla^2\Phi = -\rho \tag{2.1b}$$

We compute the forces due to the chameleon and gravitational scalars by taking their gradients:

$$\mathbf{F}_{(\phi)} = \nabla\phi, \qquad \mathbf{F}_{(\Phi)} = \nabla\Phi \tag{2.2}$$

3 Numerical methods

- Solve (2.1a) via gradient flow; finite difference derivatives discretized to fourth order accuracy.
- Solve (2.1b) via SoR; discretized to second order accuracy.
- The forces (2.2) are computed with finite difference derivatives discretized to fourth order

Acknowledgements

A Schemes

SoR

$$Q^{n+1}_{i,j} = (1-\omega)Q^n_{i,j} + \frac{\omega}{4}\left[Q^n_{i+1,j} + Q^{n+1}_{i-1,j} + Q^n_{i,j+1} + Q^{n+1}_{i,j-1} + h^2\rho\right] \tag{A.1}$$

Fourth order finite difference derivatives

$$\frac{\partial Q}{\partial x} \approx \frac{-Q_{i+2} + 8Q_{i+1} - 8Q_{i-1} + Q_{i-2}}{12h} \tag{A.2}$$

$$\frac{\partial^2 Q}{\partial x^2} \approx \frac{-Q_{i+2} + 16Q_{i+1} - 30Q_i + 16Q_{i-1} - Q_{i-2}}{12h^2} \tag{A.3}$$