Electronic Transactions on Numerical Analysis.
Volume 39, pp. 186-201, 2012.

ISSN 1068-9613.

ETNA
Kent State University
http://etna.math.kent.edu

SPECTRAL ANALYSIS OF A BLOCK-TRIANGULAR PRECONDITIONER FOR THE BIDOMAIN SYSTEM IN ELECTROCARDIOLOGY*

LUCA GERARDO-GIORDA† AND LUCIA MIRABELLA‡

Abstract. In this paper we analyze in detail the spectral properties of the block-triangular preconditioner introduced by Gerardo-Giorda et al. [J. Comput. Phys., 228 (2009), pp. 3625-3639] for the Bidomain system in non-symmetric form. We show that the conditioning of the preconditioned problem is bounded in the Fourier space independently of the frequency variable, ensuring quasi-optimality with respect to the mesh size. We derive an explicit formula to optimize the preconditioner performance by identifying a parameter that depends only on the coefficients of the problem and is easy to compute. We provide numerical tests in three dimensions that confirm the optimality of the parameter and the substantial independence of the mesh size.

Key words. electrocardiology, Bidomain system, preconditioning, finite elements

AMS subject classifications. 65M60, 65M12, 65F08

* Received March 1, 2010. Accepted February 23, 2012. Published online on June 18, 2012. Recommended by A. Klawonn.

† BCAM – Basque Center for Applied Mathematics, Bilbao, Spain (lgerardo@bcamath.org).

‡ Walter H. Coulter Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA (lucia.mirabella@bme.gatech.edu).