ON THE USE OF LEE'S PROTOCOL FOR SPECKLE-REDUCING TECHNIQUES

E. MOSCHETTI[1], M. G. PALACIO[1], M. PICCO[1], O. H. BUSTOS[2] and A. C. FRERY[3]

[1] *Departamento de Matemática*
Facultad de Ciencias Exactas Físico Química y Naturales
Universidad Nacional de Río Cuarto
Ruta 36 km 601, X5804BYA Río Cuarto – Argentina
{emoschetti;gpalacio;mpicco}@exa.unrc.edu.ar
[2] *Facultad de Matemática, Astronomía y Física*
Universidad Nacional de Córdoba
Ing. Medina Allende esq. Haya de la Torre, 5000 Córdoba – Argentina
obustos@arnet.com.ar
[3] *Instituto de Computação*
Universidade Federal de Alagoas
57072-970 Maceió, AL – Brasil
acfrery@pesquisador.cnpq.br

***Abstract*— This paper presents two new MAP (Maximum a Posteriori) filters for speckle noise reduction and a Monte Carlo procedure for the assessment of their performance. In order to quantitatively evaluate the results obtained using these new filters, with respect to classical ones, a Monte Carlo extension of Lee's protocol is proposed. This extension of the protocol shows that its original version leads to inconsistencies that hamper its use as a general procedure for filter assessment. Some solutions for these inconsistencies are proposed, and a consistent comparison of speckle-reducing filters is provided.**

***Keywords*— Filters, image processing, image quality, simulation, speckle.**

I. INTRODUCTION

Contemporary remote sensing relies on data from different regions of the electromagnetic spectrum, the optical, infrared, and microwaves ones. Synthetic Aperture Radar (SAR) sensors are becoming more relevant in every field of research and development that employs remotely sensed data, since they are active and, thus, not requiring external sources of illumination. They can observe the environment in a wavelenght that is little or not affected at all by weather conditions, providing complementary information to the conventional optical sensors.The information these sensors provide is relevant for every remote sensing application, including environmental studies, anthropic activities, oil spill monitoring, disaster assessment, reconnaissance, surveillance and targeting, among others.

As every image obtained using coherent illumination, as is the case of laser, sonar and ultrasound-B imaging, SAR images suffers from speckle noise. Such type of noise do not follows classical Gaussian additive, it is multiplicative noise. Classical techniques for noise reduction are thus inefficient to combat speckle (see, for instance, Allende *et al.*, 2001; Delignon and Pieczynski, 2002; Kuttikkad and Chellappa, 2000; Medeiros *et al.*, 2003; Touzi, 2002).

Since speckle noise hampers the ability to identify objects, many techniques have been proposed to alleviate this issue. Techniques are applied during the generation phase of the images (multilook processing, see Lopes *et al.*, 1990) or after the data is available to the users (processing with filters). A "good" technique must combat speckle and, at the same time, preserve details as well as relevant information.

In order to assess the performance of speckle-reduction techniques (multilook or filter-based), Lee *et al.* (1994) proposed a protocol. It consists of a phantom image corrupted by speckle noise processed by speckle-reduction tecniques. Measures of quality are computed on the images obtained, and the performance of the used tecnhique is assessed from these measures. This protocol can be applied to both multilook or filter-based speckle-reduction procedures. In this paper we will discuss the use of this protocol, termed "Lee's protocol", on filter-based techniques.

This papers presents situations where Lee's protocol is inadequate and should be replaced by Monte Carlo experiments; the outline of such simulation is presented. This approach aims at results that are representative for a collection of images, while the ones provided by Lee's protocol regard only one image and,