Second Harmonic Generation (SHG) signals present polarization-sensitivity characterized by the first-order hyperpolarizability tensor [1]. The combination of polarization and SHG microscopy has been employed as potential technique in architecture-organization analysis of collagen fibers [2], to optimize the signal from collagen-based tissues [3] and to explore pathological disorders [4]. Moreover, polarimetric confocal microscopy has demonstrated improved ocular structure imaging [5]. Since the accuracy of a diagnosis depends on the quality of the acquired images, the aim of this work is to apply the Mueller-matrix (MM) formalism to SHG images of tissues containing collagen.

SHG imaging was carried out by combining a polarization state generator (PSG) unit and a custom multiphoton microscope [6]. Sets of SHG images were acquired for four independent polarization states of the PSG. From these images, the spatially-resolved first row of the MM was computed. These MM elements were then used in a polarimetric procedure [5] to reconstruct the images with the best and lowest quality for different image quality metrics. Imaged samples corresponded to ocular structures, such as cornea and sclera.

Results show that the best reconstructed SHG images present a better quality that the original images. In particular, the best images for maximum transmittance and entropy (see Fig. 1) disclose details and features unseen before. The improved visualization of collagen tissues at both local and global scales could be of particular interest to clinical diagnosis since it could aid in the early detection of pathologies related to collagen denaturation.

![Fig. 1: Reconstructed images for maximum and minimum transmittance (T) and entropy (E), corresponding to a histological sample of human sclera. Scale bar: 50 µm.](image)


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