Demyelination, the loss of the myelin sheath that insulates axons, is a prominent feature in many neurological disorders including multiple sclerosis and spinal cord injury and it results in the disruption of signals within the axons. The myelin sheath can be replaced by a process called remyelination, in which endogenous oligodendrocyte progenitor cells are recruited to an area of demyelination and differentiate into mature oligodendrocytes that wrap myelin around the demyelinated axons. Remyelination, however, does not reach completion in animal models of spinal cord injury. Therapies are being developed to either enhance the amount of endogenous remyelination, or to enhance the amount of remyelination with cellular transplant. It is important to quantify the amount of remyelination that is attributable to such therapies so as to appreciate their effectiveness in addressing the issues of demyelination at the cellular level.

We propose a new technique to automatically identify the remyelinated axons based on iso-contour analysis of the image at progressively increasing intensity levels. This axon identification scheme is shape independent and makes use of the variational property of the intensities of the cell structures in the cross-sectional microscopic images of stained spinal cords. These images show a mixture of normally myelinated axons, and remyelinated cells that differ in their relative shapes and myelin sheath thickness around them. We employ sophisticated geometric algorithms to clean up the identified axons and to analyze the structure to recognize the oligodendrocyte-remyelinated axons. The results of this algorithm for automatic identification, classification, and counting of remyelinated axons are corroborated by extensive cross-verification by the domain experts.