Calculating geometric phase evolution from Jones calculus

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Although geometric phase was first discovered by Pancharatnam in 1956, and rediscovered by Michael Berry in 1984, theoretical work could not provide a model for how geometric phase evolves as it propagates through an optical system. With the new wave description of geometric phase, we show that this is in fact easy, using familiar tools of Jones calculus. We describe how to implement a simple polarization analysis to track the evolution of geometric phase as it moves through an optical element, and through a sequence of elements in a system. The final results that we obtain agree with existing theory, but provide far better insight into the physical behavior of the polarized wave and how to control the phase. These will be illustrated by showing polarization states on the Poincaré sphere, together with the corresponding curves showing the geometric phase at each point along the path. This is the first time that such evolution curves of geometric phase have become possible.

Short biography:

Nathan Hagen is a Professor of Optical Engineering at Utsunomiya University. He obtained his PhD in Optical Sciences from the University of Arizona in 2007, and worked for 5 years as the principal scientist at the successful startup Rebellion Photonics, Inc. His research focuses on spectral imaging, polarization, and optical system design.

Luis Garza Soto graduated from Utsunomiya University's Dept. of Optical Engineering in 2023. He received an MS degree in applied physics from Instituto Tecnologico de Monterrey in 2020.