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Autonomous dark soliton detection JUSTYNA ZWOLAK, National Institute of Standards and Technology, AMILSON FRITSCH, Joint Quantum Institute, National Institute of Standards and Technology and University of Maryland, JUSTIN ELENEWSKI, IREAP, University of Maryland College Park, IAN SPIELMAN, National Institute of Standards and Technology — Solitary waves (solitons) are non-dispersing localized traveling waves that retain their size, shape, and speed as they move, and even when they collide with one another. In a repulsively interacting 1D Bose-Einstein condensates (BEC), the soliton velocity governs the width, depth, and even stability of a soliton. To study solitons dynamics, a number of absorption images need to be manually analyzed to obtain the number of solitons present and their position. These solitons must be distinguished from a background of additional excitations. We developed an automated two-step protocol for detecting dark solitons in two-component BECs. Our algorithm combines two neural networks pre-trained using simulated and real data to: (1) identify the number of solitons present in BEC and (2) determine their position. This automated detector highlights the applicability of machine learning-driven feature detection, rather than traditional curve fitting, to streamline cold atom research.

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