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Kinematics and trajectory generation for MIRADAS arms

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Abstract

The Mid-resolution InfRAreD Astronomical Spectrograph (MIRADAS) is a NIR multi-object spectrograph for the Gran Telescopio Canarias (GTC). The instrument has a multiplexing system (MXS) that enables the simultaneous observation of twenty objects located within its field of view. These user selected targets are acquired by twenty deployable robotic probe arms with pickoff mirror optics operating at cryogenic temperatures. The MIRADAS probe arm is a close-loop mechanism designed with optics simplicity in mind, presenting good stability when it is operated upside down. Calculating optimum collision-free trajectories requires a good knowledge of the MIRADAS arm behavior based on its geometry and its mechanical constraints. This study introduces a geometric model for the two degree-of-freedom (DoF) mechanism, including solutions for the forward and inverse kinematics problem. The concepts of zone-of-avoidance (ZoA), workspace and envelope of MIRADAS arm are presented and studied. Finally, the paper proposes two different patrolling approaches that can be exploited when planning trajectories.