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An Auto-Lock Laser System for Long Term Frequency Stabilization[1] ROBERT BERTHIAUME, ANDREW VOROZCOVS, A. KUMARAKRISHNAN, York University — We have developed a compact, digitally controlled system to automatically stabilize the frequency of an external cavity diode laser to an atomic resonance. The key component of the system is a low-cost single-board computer with A/D and D/A capability that acts as a specialized lock-in amplifier. The system performs pattern matching between Doppler-free peaks obtained by scanning the laser frequency and reference peaks stored in the processor's memory. The incoming spectral signals are compared with the reference waveforms using a sliding correlation algorithm, which determines the control voltage required for adjusting the laser frequency to the desired lock point. The system has a scan amplitude of less than 1MHz when locked and it can re-lock for frequency drifts up to 10 GHz without human intervention. The dependence of laser frequency stability on ambient temperature, humidity, and pressure has been investigated. The performance of the system is suitable for experiments in atom trapping and atom interferometry that require long-term laser frequency stabilization.

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