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Title: Simulation Studies of the Recovery of Transiting Planet Signatures inthe Kepler Mission Transiting Planet Search Algorithm
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Abstract:

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In order to understand the capabilities and limitations of the Transiting Planet Search (TPS) algorithm, a study was performed in which simulated transiting planet signatures were added to the flux time series of 10,000 target stars, and the resulting composite light curves were analyzed using TPS. The target stars employed in the study have effective temperatures below 7600 K and log g values above 4.0, in order to limit the study to detection probabilities of planets circling FGKM dwarf stars. In order to simplify interpretation of the study, the target stars were also limited to cases in which no pre-existing signal resembling a transiting planet was present; this was accomplished by requiring that the maximum "bare" transiting planet significance be 6.5 sigmas or lower, compared to the TPS detection threshold of 7.1 sigmas. For each target selected, the full flux available through Quarter 16 was utilized. The synthetic planets were uniformly distributed in radius from 0.5 to 3.0 Earth radii and in orbital period from 50 to 150 days. Assignment of synthetic planets to target stars was completely random: in particular, no attempt was made to sort the planet-star assignments in order to produce large expected detection statistics. It was observed that, when false alarm rejection logic was disabled, the recovery probability was somewhat lower than theoretical expectations: in particular, at the nominal threshold of 7.1 sigmas, just under 35% of planets were detected, compared to an expected detection of 50%; and at 10.1 sigmas, 90% of simulated planets were detected, compared to an expectation of near-perfect recovery. When the false alarm rejection logic was enabled, recovery probability deteriorated considerably: in this case, the 7.1 sigmas recovery rate was just over 10%, and the 10.1 sigmas rate was below 70%. The results indicate that further optimization of both the base detection algorithm and the false alarm veto algorithms is required in order to detect the smallest planet signatures in the Kepler field of view.