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Fast scenario design for alternative magnetic diverted discharge on EAST

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Like any advanced tokamak devices, high heat flux to the divertor target is always a crucial issue for EAST to operate in high performance and steady sate [1]. Advanced magnetic diverted configuration, like snowflake (SF) and X-divertor, is one of the attractive methods to spread the heat fluxes over divertor targets in tokamak because of enhanced scrape-off layer transport and an increased plasma wetted area on divertor target. Exact SF configuration for EAST is only possible at very low plasma current due to poloidal coil system limitation. EAST can be operated in quite flexible plasma shapes like double null (DN) or signal null (SN) divertor configurations, but the external poloidal coils location was not optimized for the advanced diverted configurations. However, an alternative magnetic diverted configuration [2], characterized by two first-order X points where one is located in the primary separatrix and the other is outside the vacuum vessel, can be optimized to satisfy EAST constraints, like maximum current on poloidal field (PF) coils. In order to build the alternative magnetic diverted discharge in EAST, a fast scenario design tool based on EFIT & F2EQ code has been developed. A series of coil currents can be calculated and optimized based on a given alternative magnetic diverted configuration and desired pulse length. These coil currents will be offered to plasma control system (PCS) as feedforward coil currents. Then desired alternative magnetic configuration will be achieved at the scenario with specified time slice with the help of the designed feedforward and the feedback coil currents by RZIP or ISOFLUX algorithm control. This scenario design tool can provide a fast way to operate a new configuration discharge without using time-consuming TSC code, and reduce the operation runtime requirements for a new diverted configuration discharge. This method can also provide a fast scenario development for further new diverted configuration like negative triangularity shape or ITER-like SN configuration on EAST.

References

[1] J. Li, et al., Nat. Phys. 9, 817, 2013

[2] G. Calabrò, B.J. Xiao, S.L. Chen, et al., Nucl. Fusion, 55, 083005, 2015

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