Metric operator for PT-symmetric models: perturbation theory approach

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We explain how the analytic perturbation theory can be used to obtain general results on the structure of the metric operator Θ of PT-symmetric perturbations of Dirichlet or Neumann Laplacian on finite interval. More precisely, we consider bounded (not necessarily potential) and form-bounded (complex Robin boundary conditions) perturbations. We formulate necessary and sufficient conditions for the existence of Θ for the studied operators. If Θ exists, we show that it can be always expressed as $\Theta = I + K$, where K is an integral Hilbert-Schmidt operator. This result justifies the method of searching the metric operator as a solution of wave equation type PDE used in PT-symmetric literature. We illustrate the results on examples of $\mathcal{PT}$-symmetric square well and $\mathcal{PT}$-symmetric Robin boundary conditions.