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Sensitivity of matrix function based network communicability measures

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When analyzing complex networks, an important task is the identification of nodes which play a leading role for the overall communicability of the network. In the context of modifying networks (or making them robust against targeted attacks or outages), it is also relevant to know how sensitive the network's communicability is to changes in certain nodes or edges.

Recently, the concept of *total network sensitivity* was introduced in [O. De la Cruz Cabrera, J. Jin, S. Noschese, L. Reichel, *Communication in complex networks*, Appl. Numer. Math., 172, pp. 186-205, 2022], which allows to measure how sensitive the total communicability of a network is to the addition or removal of certain edges. One shortcoming of this concept is that sensitivities are extremely costly to compute when using a straightforward approach (orders of magnitude more expensive than the corresponding communicability measures).

To overcome this problem, we combine Krylov methods for computing Fréchet derivatives with a maximum element estimator for implicitly given matrices, which results in a computational procedure for estimating network sensitivity at a cost that is essentially *linear in the number of nodes* for many real-world complex networks.

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