

# Fault-Tolerant $ST$ -Diameter Oracles

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**Abstract:** We study the problem of estimating the  $ST$ -diameter of a graph that is subject to a bounded number of edge failures. An  $f$ -edge fault-tolerant  $ST$ -diameter oracle ( $f$ -FDO- $ST$ ) is a data structure that preprocesses a given graph  $G$ , two sets of vertices  $S, T$ , and positive integer  $f$ . When queried with a set  $F$  of at most  $f$  edges, the oracle returns an estimate  $\widehat{D}$  of the  $ST$ -diameter  $diam(G - F, S, T)$ , the maximum distance between vertices in  $S$  and  $T$  in  $G - F$ . The oracle has stretch  $\sigma \geq 1$  if  $diam(G - F, S, T) \leq \widehat{D} \leq \sigma \cdot diam(G - F, S, T)$ . If  $S$  and  $T$  both contain all vertices, the data structure is called an  $f$ -edge fault-tolerant diameter oracle ( $f$ -FDO).

We design new  $f$ -FDOs and  $f$ -FDO- $ST$ s via reductions from both  $\text{all-pairs}$  and  $\text{single-source}$   $f$ -edge fault-tolerant Distance Sensitivity Oracles ( $f$ -DSOs), i.e., oracles that can estimate distances even when up to  $f$  edges of  $G$  fail. We obtain new tradeoffs between the size of the data structure, stretch guarantee, query and preprocessing times for  $f$ -FDOs and  $f$ -FDO- $ST$ s by combining our reductions with the  $\text{all-pairs/single-source}$   $f$ -DSOs of Weimann and Yuster [FOCS 2010], Chechik et al. [ESA 2010], Baswana and Khanna [STACS 2010], Chechik et al. [SODA 2017], Brand and Saranurak [FOCS 2019], Duan and Ren [STOC 2020], Bilò et al. [Algorithmica 2022], Singh and Gupta [ICALP 2018], and Baswana et al. [SODA 2018].

We also provide an information-theoretic lower bound on the space requirement of approximate  $f$ -FDOs. We show that there exists a family graphs for which any  $f$ -FDO with sensitivity  $f \geq 2$  and stretch less than  $5/3$  requires  $\Omega(n^{3/2})$  bits of space, regardless of the query time.

**Presenter:** BILÒ, Davide

**Session Classification:** Track A-3