Spindle subdivisions in digraphs

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Resumo/Abstract:
For a positive integer b and a non-negative integer d, a (b, d)-*spindle* is the digraph containing b internally disjoint paths $P_1, \ldots, P_b$ of length at most d from a vertex u to a vertex v. In a (b, d)-spindle, we call b its breadth and d its depth. We say that a digraph is a *spindle* if it is a (b, d)-spindle for some integers b and d. Given a digraphs D and a spindle F of depth d, the Spindle d-Subdivision problem consists of deciding whether D contains a subdivision of F. We prove that Spindle d-Subdivision is polynomial time solveable for $d \leq 3$. In contrast to this result, we prove Spindle d-Subdivision is NP-complete for $d \geq 4$, even when restricted to acyclic digraphs. We prove that deciding whether an acyclic digraph on n vertices contains a subdivision of a (b, d)-spindle can be solved in $O(d^b n^{2b+1})$ time. We also study a few variations of the problem of finding spindles in digraphs, including showing optimal FTP-algorithms under ETH and proving W[1]-hardness results.