Hearing a prey in a spider orb-web

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The study of biological–mechanical systems has always interested engineers, physicists and applied mathematicians. The spider orb-web has as its primary function to provide information to the spider, so that it can catch prey. The majority of spiders use the information obtained from the vibration of the web, captured by its legs as the principal guide for localizing the presence of a prey. Here we consider the inverse problem of determining the position of a vibration source from dynamic measurements taken in a ring centered at the origin of the spider orb-web. We prove that for sources of the form $g(t)f(x)$ where $g(t)$ is a known function of time, the spatial force distribution $f(x)$ can be uniquely determined from the measurement of the transverse displacement taken on an arbitrarily small and thin ring centered at the origin of the web, where the spider is supposed to stay, for a sufficiently large interval of time. The spider orb-web is modeled by a partial differential equation with a singularity at the origin.

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