An online procedure for evaluating the magnetic flux density emitted by complex conductor systems

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The "Nello Carrara" Institute of Applied Physics at the National Research Council (CNR-IFAC) has developed the WebNIR portal, "Web Tools for Evaluating Occupational Exposure to Non-Ionizing Radiation" (https://webnir.eu). This portal provides several specialized tools, including one that calculates the magnetic flux density generated by systems of conductors with mixed geometries, such as broken lines, catenaries, and circular loops. This tool enables assessments in various environments (laboratories, workshops, clinics) where field sources can be modeled as combinations of simple conductors, including coils, solenoids, and linear or suspended conductors. For catenaries, approximations are made with segmented lines, while a precise calculation procedure developed by INFN for circular loops has been implemented, utilizing Python scientific packages (especially NumPy). This significantly improves computation times by at least an order of magnitude. The tool has been internally validated through comparisons with independently derived procedures, yielding positive results. The calculation tool is designed to integrate with visualization and mapping software such as QGIS, enabling the import/export of conductor geometries and simulation results in compatible formats for further analysis. It is applicable in both protective and accelerator physics contexts, supporting evaluations of magnetic induction inside coil structures, particularly off-axis behavior.