OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

CHAIR OF ELECTROMAGNETIC COMPATIBILITY

Solutions of the Biot-Savart Law for Straight Wires with a Nonuniform Current Distribution

Background and problem: The Biot-Savart law can be used to calculate the magnetic field the surrounds a current-carrying wir The general solution which can be found in the literature assumes that the wire is straight, that the current only flows in the cente of the wire and that the current distribution along the wire is uniform. For some applications it is necessary to deal with a nonuniform current distribution, for example if the current along the wire decreases continuously due to stray currents. A typical workaround is to approximate a long wire carrying a nonuniform current distribution with shorter wire section carrying a uniform current distribution. This is of course inefficient and inaccurate.

Task: The main objective is to find possible nonuniform current distribution that allow for an analytical solution of the Biot-Savart law. Therefore computer algebra systems like Maple or Mathematica might be used.

Supervisor: › Dr. Ing. Mathias Magdowski (https://lsf.ovgu.de/qislsf/rds?state=verpublish&status=init&vmfile=no&moduleCall=webInfo&publishConfFile=webInfoPerson&publishSubDir=personal&keep=y&purge=y&personal.pid=852&noDBAction=y&init=y)

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