Covariant boundary conditions in electromagnetism

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A most compact and elegant description of the electromagnetic fields in media and in vacuum is attained in the differential forms formalism. This description is explicitly Lorentz and general relativistic invariant. Moreover, it is independent of the geometry of the underline spacetime. The volumetric electric charge and current densities are represented by non-singular differential 3-forms. The charge and current densities with a support on the low dimensional submanifolds (surfaces and strings) naturally require singular differential forms. We present a covariant metric-free definitions of the surface and string densities. It is shown that this covariant description requires Dirac's delta-forms instead of delta-functions. Covariant metric-free conservation laws for the surface and string densities are derived. Based on the definition of the surface electric current, we derive the metric-free covariant boundary conditions in electromagnetism. The applications of these boundary conditions are demonstrated.

References

[1] Y. Itin, *Surface and string electric charges. Covariant description*, to appear

[2] Y. Itin, *Covariant boundary conditions in electromagnetism*, to appear