Classification of first order sesquilinear forms

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Abstract. We work with n complex-valued scalar fields over an m-dimensional real manifold M without boundary. Our object of study is a first order Hermitian sesquilinear form, i.e. an integral over the manifold whose integrand is a linear combination of terms "product of gradient of scalar field and scalar field" and "product of two scalar fields", with complex conjugation in the appropriate places.

We call two sesquilinear forms equivalent if one is obtained from the other by some x-dependent $\mathrm{GL}(n, \mathbb{C})$ transformation, i.e. by a change of basis in the vector space of n-tuples of complex-valued scalar fields. Our aim is to provide a description of equivalence classes of sesquilinear forms.

The main result of the talk is that in the special case $m = 4$, $n = 2$ we provide explicit necessary and sufficient conditions for two sesquilinear forms to be equivalent. In the process of formulating these necessary and sufficient conditions we show that a first order Hermitian sesquilinear form implicitly contains geometric constructs such as Lorentzian metric, spin structure, connection coefficients and electromagnetic covector potential.

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