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New results on induced almost contact structure on product manifolds

E. Abedi
University of Shahid Madani Azarbaijan

G.H. Haghighatdoost
University of Shahid Madani Azarbaijan

S. M. Mousavi*
Bonab Islamic Azad University

Abstract

In this paper, first, we investigate some new results on relations between the structures J (on almost Hermitian manifold M) and Σ (on almost contact metric manifold N) with the induced almost contact metric structure $\overline{\Sigma}$ on $M \times N$ by the mentioned structures.

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1 Preliminaries

1.1 Almost Hermitian and almost hypercomplex structures

Let M be an even-diminational differentiable manifold. An almost Hermitian structure on M is by definition a pair (J, g) on almost complex structure J and a Riemannian metric g satisfying

$$J^2X = -X, \quad g(JX, JY) = g(X, Y) \tag{1}$$

for any vector fields X, Y on M.

The fundamental form Ω of an almost Hermitian structure is defined by

$$\Omega(X, Y) = g(JX, Y)$$

for any vector fields X, Y and is skew-symmetric. An almost Hermitian manifold is called an almost Kähler manifold if its fundamental form Ω is closed, that is, $d\Omega = 0$.

The Neijenhuis (or the torsion) tensor of an almost complex structure J is defined dy

$$\mathcal{N}(X, Y) = [X, Y] - [JX, JY] + J[X, JY] + J[JX, Y] \tag{2}$$

for any vector fields X , Y on M. An almost complex structure is said to be integrable if it has no torsion. It is well known that an almost complex structure is a complex structure if and only if it is integrable ([6]). A complex manifold with a Hermitian structure (J, g) is said to be Kählerian if its fundamental form is closed, which is equvalent to

$$\nabla J = 0. \tag{3}$$

*Speaker