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Class AK-manifold of Concircular curvature tensor (V)

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ABSTRACT

The current deals with new Three classes of almost Kahler manifold W2 of Concircular curvature tensor are Calculating differential geometrical but also topological parameters appropriate for new classes $\overline{V}1$, $\overline{V}2$, and $\overline{V}3$, are the focus of the paper. Through it, an equivalence relationship was obtained between these classes and one of or more the Tensor compound in the adjoint G-structure space and then construct a relation between this new classes.

Introduction

Three different kinds of almost Hermitian manifolds, each of which is defined in terms of the Riemannian curvature tensor, were established by A.Gray [1].These classes are designated as R_1, R_2, and R_3. The class R_1 stipulates what a parakahler manifold [2]. The R_3 class includes RK-manifolds [3].The identities of R_1, R_2, and R_3 were demonstrated by A. Gray [1],[4] and [5] to the fundamental concept for comprehending the differential-geometrical properties of Kahler manifolds. Following are the components that make up the Riemannian curvature tensor:

R_1:$< R(\kappa_1,\kappa_2)\, \kappa_3,\kappa_4> =<R(J\kappa_1,J\kappa_2)\, \kappa_3,\kappa_4>$;

R_2: $< R(\kappa_1,\kappa_2)\, \kappa_3,\kappa_4> =<R(J\kappa_1,J\kappa_2)\, \kappa_3,\kappa_4> +< R(J\kappa_1,\kappa_2)\, J\kappa_3,\kappa_4> +<R(J\kappa_1,\kappa_2)\, \kappa_3,J\kappa_4>$

R_3: $< R(\kappa_1,\kappa_2)\, \kappa_3,\kappa_4> =<R(J\kappa_1,J\kappa_2)\, J\kappa_3,J\kappa_4>$

The AH-structures belonging to the class R_i have a tensor R that fulfills the identity R_i. If AH-any subclass of H-structures is named $\cap R_i =0$, where i is 1, 2, or 3, then it exists. [5] . It is common knowledge that V, R_1, R_2, R_3 [6]. As a result, it makes sense to expect that the manifold class, R_1 manifold class, and lastly the manifold of class R_3 are among the AH-manifolds that are closest to the Kahler manifold class for differential - geometrical and topological properties. AH -structures, Concircular tensor (V) which satisfies to identity V_i, are referred to as the structures. of class V_i. If $\theta \subset$AH- any sub class of AH-structures designations $\cap R_i$= s where i= 1, 2, 3 well - known that $V\subset V_1\subset V_2\subset V_3$ [4]. In light of this, it makes sense to anticipate that the H-manifolds with the closest geometrical and topological features will be the ones to the Vaishman - Gray manifold class, manifold classV_1, manifold class V_2 , but rather finally, manifold of class V_3 . In this paper, we will generalize these relationships, definitions and theories related to them for almost Kahler manifold W_2 of Concircular curvature tensor

Preliminaries

Assuming M is a smooth manifold of size 2n, $C^{\wedge\infty}(M)$ is represents an algebra of smooth functions on M, and X(M) is really a module of smooth vector fields on M. The following assumes that all objects are of class $C^{\wedge\infty}(M)$ and include manifold, tensor fields, Therefore, J-almost complex structure ($J^{\wedge 2}$=id) on M ,g=<.,.> and Almost Hermition (is short, AH) structure on a manifold M the couple (J, g). pseudo metric Riemannian on M. In this instance <Jϑ,Jα> =<ϑ,α> ;ϑ,α∈X(M).

Definition 1 [4]

If the basic form Ω (τ, μ) = <τ, Jμ> closed i. e d Ω = 0, the Hermition manifold is said to be approximately < M, J, g =. ,.> has an almost Kahler structure (AK structure). A manifold that is smooth M with an AK- chassis is referred to as a roughly Kahler manifold (AK-manifold).

Definition 2 [3]

A class manifold is denoted by the letters (M, J, g) such that :

1) $\bar{V}_1$ if < V (κ$_1$, κ$_2$) κ$_3$, κ$_4$ > = <V(κ$_1$, κ$_2$) Jκ$_3$, Jκ$_4$>; 2)$\bar{V}_2$ if < V(κ$_1$,κ$_2$) κ$_3$,κ$_4$ >= < V(Jκ$_1$, Jκ$_2$) κ$_3$,κ$_4$> + <V(Jκ$_1$, κ$_2$) Jκ$_3$, κ$_4$> + < V(Jκ$_1$, κ$_2$) κ$_3$, Jκ$_4$ > ; 3)$\bar{V}_3$ if <V(κ$_1$, κ$_2$) κ$_3$, κ$_4$> = <V(Jκ$_1$, Jκ$_2$) Jκ$_3$, Jκ$_4$>;

Note3:

From history theorem which states ((The following are our inclusion relationships: i)$V_0 = V_3$, ii) $V_1 = V_2$, iii) $V_4 = V_7$, iv) $V_5 = V_6$)).

We follows that AK-manifold of class $V_0 = V_3 = V_5 = V_6$ are also class $\bar{V}_3$ manifolds. The meaning of the specified curvature identities of is most obvious when expressed in terms of an a spectrum Concircular curvature tensor.

Theorem 4

Consider W = (J, g = < . , . >) represents almost Kahler manifold .Then the following statements are identical in this case :

1) W denote a class's structure of $\bar{V}_3$;

2)$V_{(0)} = 0$ and

(3) The identities $V^a_{bcd} = 0$ are reasonable in space of adjont G-structure space.

Proof:

Consider W denote a class's structure of $\bar{V}_3$. W without doubt, the same as identity V(κ$_1$, κ$_2$) κ$_3$ + J V(Jκ$_1$, Jκ$_2$) Jκ$_3$ = 0 ; κ$_1$, κ$_2$, κ$_3$ ∈X(M)

Spectral tensors are defined as follows:

V(κ$_1$, κ$_2$) κ$_3$= V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(1)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(2)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(4)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(5)}$(κ$_1$,κ$_2$)κ$_3$+V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(7)}$(κ$_1$,κ$_2$)κ$_3$;κ$_1$,κ$_2$,κ$_3$ ∈X(M)

J∘V(Jκ$_1$, Jκ$_2$) Jκ$_3$ = J∘ V$_{(0)}$(Jκ$_1$, Jκ$_2$) Jκ$_3$ +J∘ V$_{(1)}$(Jκ$_1$, Jκ$_2$) Jκ$_3$ +J∘ V$_{(2)}$(Jκ$_1$,J κ$_2$) Jκ$_3$ +J∘ V$_{(3)}$(Jκ$_1$, Jκ$_2$) Jκ$_3$ + J∘V$_{(4)}$(Jκ$_1$, Jκ$_2$) Jκ$_3$ +J∘V$_{(5)}$(Jκ$_1$, Jκ$_2$) Jκ$_3$ + J∘ V$_{(6)}$(Jκ$_1$, Jκ$_2$) Jκ$_3$ + J∘V$_{(7)}$(Jκ$_1$,Jκ$_2$) Jκ$_3$

= V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ - V$_{(1)}$(κ$_1$, κ$_2$) κ$_3$- V$_{(2)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ - V$_{(4)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ - V$_{(7)}$(κ$_1$, κ$_2$) κ$_3$; κ$_1$, κ$_2$, κ$_3$ ∈X(M)

These identities will be defined as follows:

V(κ$_1$, κ$_2$) κ$_3$+ JV(Jκ$_1$, Jκ$_2$) Jκ$_3$ ={ V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(6)}$(κ$_1$, κ$_2$) }

The identity is shaped by resources V(κ$_1$, κ$_2$) κ$_3$ + J V(Jκ$_1$, Jκ$_2$) Jκ$_3$= 0 is equal V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ and this identity is the same as other identities $V_{(0)} = V_{(3)} = V_{(5)} = V_{(6)} = 0$.

The following relations can be derived from the obtained identities on the adjoint G-space: structure's, according to characteristics (3) :

$V^a_{bcd} = V^a_{b\hat{c}\hat{d}} = V^a_{\hat{b}c\hat{d}} = 0$.

Because of materiality tensor$C$and its properties(3) received relations that are identical to $V^a_{bcd} = 0$, this mean identity V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$= 0 According to [5], *the exact* opposite is true.

Theorem 5

Consider W = (J, g = <., .>) represents almost Kahler structure. Then the following statements are identical in this case:

(1) W denote a class's structure of $\bar{V}_2$;

(2)$V_{(0)} = V_{(7)} = 0$; and

(3) On the associated G-structure identities space $V^a_{bcd} = V^a_{\hat{b}\hat{c}\hat{d}} = 0$ are they reasonable $V^a_{bcd} = V^a_{\hat{b}\hat{c}\hat{d}} = 0$

<u>Proof</u>:

Consider W- structure of a class $\bar{V}_2$ be the case identity $\bar{V}_2$ will be copied in the following format.

The identity will compute based on the notion of a spectrum tensor once every one has been assembled:

1) V(κ$_1$, κ$_2$) κ$_3$= V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(1)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(2)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(4)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(7)}$(κ$_1$, κ$_2$) κ$_3$; κ$_1$, κ$_2$, κ$_3$ ∈X(M)

2) V(Jκ$_1$, Jκ$_2$) κ$_3$= V$_{(0)}$(Jκ$_1$, Jκ$_2$) κ$_3$ +V$_{(1)}$(Jκ$_1$, Jκ$_2$) κ$_3$ + V$_{(2)}$(Jκ$_1$,J κ$_2$) κ$_3$ +V$_{(3)}$(Jκ$_1$, Jκ$_2$) κ$_3$ +V$_{(4)}$(Jκ$_1$, Jκ$_2$) κ$_3$ +V$_{(5)}$(Jκ$_1$, Jκ$_2$) κ$_3$ + V$_{(6)}$(Jκ$_1$, Jκ$_2$) κ$_3$ +V$_{(7)}$(Jκ$_1$,Jκ$_2$)κ= - V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(1)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(2)}$(κ$_1$, κ$_2$) κ$_3$ -V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ -V$_{(4)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ - V$_{(7)}$(κ$_1$, κ$_2$) κ$_3$; κ$_1$, κ$_2$, κ$_3$ ∈X(M)

3) V(Jκ$_1$,κ$_2$)Jκ$_3$=V$_{(0)}$(Jκ$_1$,κ$_2$)Jκ$_3$+V$_{(1)}$(Jκ$_1$,κ$_2$)Jκ$_3$+V$_{(2)}$(Jκ$_1$,κ$_2$)Jκ$_3$+V$_{(3)}$(Jκ$_1$,κ$_2$)Jκ$_3$+V$_{(4)}$(Jκ$_1$,κ$_2$)Jκ$_3$+V$_{(5)}$(Jκ$_1$, κ$_2$)Jκ$_3$+V$_{(6)}$(Jκ$_1$,κ$_2$)Jκ$_3$+V$_{(7)}$(Jκ$_1$,κ$_2$)Jκ$_3$= -V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ -V$_{(1)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(2)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(4)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ - V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ - V$_{(7)}$(κ$_1$, κ$_2$) κ$_3$; κ$_1$, κ$_2$, κ$_3$ ∈X(M)

4) JV(Jκ$_1$, κ$_2$) κ$_3$= JV$_{(0)}$(Jκ$_1$, κ$_2$) κ$_3$ +JV$_{(1)}$(Jκ$_1$, κ$_2$) κ$_3$ + JV$_{(2)}$(Jκ$_1$, κ$_2$) κ$_3$ +JV$_{(3)}$(Jκ$_1$, κ$_2$) κ$_3$ +JV$_{(4)}$(Jκ$_1$, κ$_2$) κ$_3$ +V$_{(5)}$(Jκ$_1$, κ$_2$) κ$_3$ + JV$_{(6)}$(Jκ$_1$, κ$_2$) κ$_3$ + JV$_{(7)}$(Jκ$_1$, κ$_2$) κ$_3$= - V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ -V$_{(1)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(2)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ -V$_{(4)}$(κ$_1$, κ$_2$) κ$_3$ -V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(7)}$(κ$_1$, κ$_2$) κ$_3$; κ$_1$, κ$_2$, κ$_3$ ∈X(M)

If we replace these decompositions in the previous equality, we get : V(κ$_1$, κ$_2$) κ$_3$ - V(Jκ$_1$, Jκ$_2$) κ$_3$ - V(Jκ$_1$, κ$_2$) Jκ$_3$ + JV(Jκ$_1$, κ$_2$) κ$_3$ = 2{ V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ - V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ + V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ +V$_{(7)}$(κ$_1$, κ$_2$) κ$_3$}

This identity is equivalent to that

V$_{(0)}$(κ$_1$, κ$_2$) κ$_3$ =V$_{(3)}$(κ$_1$, κ$_2$) κ$_3$ = V$_{(5)}$(κ$_1$, κ$_2$) κ$_3$ = V$_{(6)}$(κ$_1$, κ$_2$) κ$_3$ =V$_{(7)}$(κ$_1$, κ$_2$)κ$_3$= 0

$V^a_{bcd} = V^a_{b\hat{c}\hat{d}} = V^a_{\hat{b}c\hat{d}} = V^a_{\hat{b}\hat{c}d} = V^a_{\hat{b}\hat{c}\hat{d}} = 0$.

Additionally, these identities in the adjacent G-space structures are identical to those in the adjacent G-space structures.

The received relations are equal to relations due to the materiality tensor V and by history characteristics we have $V^a_{bcd} = V^a_{\hat{b}\hat{c}\hat{d}}=0$ i.e. to identities $V_{(0)}(\kappa_1, \kappa_2) \kappa_3 = V_{(7)}(\kappa_1, \kappa_2) \kappa_3$ .Allow for AK's several identities once more $V_{(0)}(\kappa_1, \kappa_2) \kappa_3=V_{(7)}(\kappa_1, \kappa_2) \kappa_3=0$ are executed.

Then by history from we have: $V(\kappa_1, \kappa_2) \kappa_3 - V(\kappa_1, J\kappa_2) J\kappa_3 - V(J\kappa_1, \kappa_2) J\kappa_3 - V(J\kappa_1, J\kappa_2) \kappa_3 = 0$; i.e.

$V(\kappa_1, \kappa_2) \kappa_3 = V(\kappa_1, J\kappa_2) J\kappa_3 + V(J\kappa_1, \kappa_2) J\kappa_3 + V(J\kappa_1, J\kappa_2) \kappa_3$.

In the received identity instead of $V(\kappa_1, J\kappa_2) J\kappa_3$ we shall put the value received history from replacement $\kappa_2 \to J\kappa_2$ and $\kappa_3 \to J\kappa_3$, i . e

$V(\kappa_1, J\kappa_2) J\kappa_3 = -JV(J\kappa_1, \kappa_2) \kappa_3$

Then

$V(\kappa_1, \kappa_2) \kappa_3 = V(J\kappa_1, J\kappa_2) \kappa_3 + V(J\kappa_1, \kappa_2) J\kappa_3 - JV(J\kappa_1, J\kappa_2) \kappa_3$

i.e.

$< V(\kappa_1,\kappa_2) \kappa_3,\kappa_4 >= < V(J\kappa_1 , J\kappa_2) \kappa_3,\kappa_4> + <V(J\kappa_1, \kappa_2) J\kappa_3, \kappa_4> + < V(J\kappa_1, \kappa_2) \kappa_3 , J\kappa_4 >$ The outcome is that the identical requirement is met by the manifold $\bar{V}_2$.

In a similar manner, the next theorem is demonstrated.

Theorem 6

Consider W = (J, g = < . , . >) represents almost Kahler manifold .Then the following statements are identical in this:

(1) W denote a class's structure of $\bar{V}_1$

(2) $V_{(0)} = V_{(4)} = V_{(7)} = 0$;

(3) associated identities on the G-structure space $V^a_{bcd} = V^a_{\hat{b}cd} = V^a_{\hat{b}\hat{c}\hat{d}}$ are reasonable .

<u>proof</u> :

Take, for example, a class's W-structure $\bar{V}_1$. It's obvious that it's the same as identity $< V (\kappa_1, \kappa_2) \kappa_3 , \kappa_4 > = <V(\kappa_1, \kappa_2) J\kappa_3 , J\kappa_4>$ as well as we have $V(\kappa_1, \kappa_2) \kappa_3 + J V(\kappa_1, \kappa_2) J\kappa_3 = 0$; $\kappa_1, \kappa_2, \kappa_3 \in X(M)$

Spectral tensors are through definition:

1) $V(\kappa_1, \kappa_2) \kappa_3= V_{(0)}(\kappa_1, \kappa_2) \kappa_3 +V_{(1)}(\kappa_1, \kappa_2) \kappa_3 + V_{(2)}(\kappa_1, \kappa_2) \kappa_3 +V_{(3)}(\kappa_1, \kappa_2) \kappa_3 +V_{(4)}(\kappa_1, \kappa_2) \kappa_3 +V_{(5)}(\kappa_1, \kappa_2) \kappa_3 + V_{(6)}(\kappa_1, \kappa_2) \kappa_3 + V_{(7)}(\kappa_1, \kappa_2) \kappa_3$; $\kappa_1, \kappa_2, \kappa_3 \in X(M)$

2) $J\circ V(J\kappa_1, J\kappa_2) J\kappa_3 = J\circ V_{(0)}(J\kappa_1, J\kappa_2) J\kappa_3 +J\circ V_{(1)}(J\kappa_1, J\kappa_2) J\kappa_3 +J\circ V_{(2)}(J\kappa_1,J \kappa_2) J\kappa_3 +J\circ V_{(3)}(J\kappa_1, J\kappa_2) J\kappa_3 + J\circ V_{(4)}(J\kappa_1, J\kappa_2) J\kappa_3 + J\circ V_{(5)}(J\kappa_1, J\kappa_2) J\kappa_3 + J\circ V_{(6)}(J\kappa_1, J\kappa_2) J\kappa_3 + J\circ V_{(7)}(J\kappa_1,J\kappa_2) J\kappa_3$

$= -V_{(0)}(\kappa_1, \kappa_2) \kappa_3 - V_{(1)}(\kappa_1, \kappa_2) \kappa_3- V_{(2)}(\kappa_1, \kappa_2) \kappa_3 - V_{(3)}(\kappa_1, \kappa_2) \kappa_3 + V_{(4)}(\kappa_1, \kappa_2) \kappa_3 - V_{(5)}(\kappa_1, \kappa_2) \kappa_3 - V_{(6)}(\kappa_1, \kappa_2) \kappa_3 + V_{(7)}(\kappa_1, \kappa_2) \kappa_3$; $\kappa_1, \kappa_2, \kappa_3 \in X(M)$.

Putting (1) and (2) in

$V(\kappa_1, \kappa_2) \kappa_3 + JV(\kappa_1, \kappa_2) J\kappa_3$ means, this identity is equivalent to that $V_{(0)}(\kappa_1, \kappa_2) \kappa_3 + V_{(4)}(\kappa_1, \kappa_2) \kappa_3+ V_{(7)}(\kappa_1, \kappa_2) \kappa_3 = 0$

This identity is also equivalent to other identities $V_{(0)} =V_{(4)}=V_{(7)}=0$.So according their history properties the adjoint G- structure's received identities in space are identical to relation $V^a_{bcd} = V^a_{\hat{b}cd} = V^a_{\hat{b}\hat{c}\hat{d}} = 0$.

Theorem 7

Consider W = (J , g = < . , . >) is an AK- structure, then the next class insertion $\bar{V}_1 \subset \bar{V}_2 \subset \bar{V}_3$ are resonable.

Proof :

Let's say a class's W-structure is $\bar{V}_1$. By history theory, it is identical to $\bar{V}_0 = \bar{V}_4 = \bar{V}_7 = 0$.

As a result of history theorem class $\bar{V}_0 = \bar{V}_7 = 0$, is identical to class $\bar{V}_2$. Then $\bar{V}_1 \subset \bar{V}_2$. Furthermore, the class $\bar{V}_3$ is the same as class $\bar{V}_0$. As shown by history theorem so $\bar{V}_1 \subset \bar{V}_2 \subset \bar{V}_3$

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صفوف تنزرالانحناء الهرمتي الدائري لمنطوي كوهلر التقريبي

ياسين خضير عباس , علي عبد المجيد شهاب

الملخص

تم تعريف ثلاث فئات جديدة من منطوي كوهلر التقريبي من تنزر الانحناء الهرمتي الدائري , ويهدف هذا البحث الى حساب الخصائص التفاضلية – الهندسية والتبلوجية الاقرب للفئات الجديدة $\bar{V}_1,\bar{V}_2,\bar{V}_3$ والتي من خلالها تم الحصول على علاقة تكافؤ بين واحدة من هذه الفئات او اكثر من مركبات تنزر الانحناء الهرمتي الدائري لمنطوي كوهلر التقريبي , واخيرا تم ايجاد علاقة بين V_1,V_2,V_3 ومع بعضها البعض .