

# An investigation of symmetric and skew-symmetric recurrent tensors of second order on 4–dimensional manifolds

Bahar Kırık

*Istanbul, TURKEY*

[baharkirik@gmail.com]

This work is in collaboration with Graham Hall. In it, we first investigate the recurrence structure of second order symmetric tensors on a 4–dimensional manifold admitting a metric whose signature is  $(+, +, -, -)$  (neutral signature). (The results for  $(+, +, +, -)$  (Lorentz signature) and  $(+, +, +, +)$  (positive definite signature) are known but will be reviewed). We present some basic concepts about 4–dimensional manifolds with neutral signature, recurrence conditions and holonomy theory. Secondly, the problem of parallel (or scalable as to be parallel), second order symmetric tensor fields is considered by using techniques based on the classification of such tensors and holonomy theory. This idea is then enlarged to recurrent tensor fields which are not in this class and which will be called properly recurrent second order symmetric tensor fields. All possible Segre types and holonomy types are found for these problems and an application of this study is given. Finally, this investigation is extended to second order skew-symmetric tensor fields which are referred to bivectors. The proper recurrence for bivectors is examined on a 4–dimensional manifold of Lorentz signature and some results related to them are given. Some remarks for this problem are also given when the metric has positive definite signature.

---