Abstracts of Australasian PhD theses

The conformal group & Einstein spaces

William Dean Halford

This thesis presents

(a)   a survey of the use of the conformal group from its
      beginnings to the present time, and

(b)   a determination of those algebraically special vacuum
      Einstein space-times with an expanding and/or twisting
      congruence of null geodesics, which locally possess a
      homothetic symmetry as well as a Killing symmetry
      (isometry).

Unless the space-time is Petrov type N with twist-free geodesic
rays, one can restrict attention to one proper homothetic motion plus the
assumed Killing motion(s).

The formalism developed to undertake the systematic search for such
vacuum space-times is an extension of the tetrad formalism used by Debney
and Kerr and Schild [1] and by Kerr and Debney [2].

The spaces which admit one homothetic Killing vector plus 2, 3 , or
4 Killing vectors are completely determined. There are 9 such metrics
(12 with 3 degeneracies) - one admitting 4 Killing vectors, one with
3 Killing vectors, and seven with 2 Killing vectors. Those spaces which
admit one homothetic Killing vector plus one Killing vector are not
completely determined owing to the field equations not being solved in some
cases. However, 9 metrics are found, many of which appear to be new.

Petrov type N vacuum spaces with expansion and/or twist which admit

William Dean Halford

a homothety are possible when one Killing vector of special type is also present, or when the homothety alone is of special type.

An extensive bibliography is given.

References

[1]   G.C. Debney and R.P. Kerr and A. Schild, "Solutions of the Einstein and Einstein-Maxwell equations", *J. Mathematical Phys.* 10 (1969), 1842-1854.

[2]   R.P. Kerr and G.C. Debney, Jr., "Einstein spaces with symmetry groups", *J. Mathematical Phys.* 11 (1970), 2807-2817.