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TRIVECTORS IN A SPACE OF SEVEN DIMENSIONS

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In their paper [1], Buseman and Glassco state that $N(C, 7, 3) = 5$ has been claimed but questioned. Schouten in [2] provides a classification of the orbits of $\Lambda^3 V$ under the action of the group of automorphisms of $\Lambda^3 V$ induced by automorphisms of V when dim $V = 7$. The only possible candidate in the list for a trivector with irreducible length 5 is ($VII\,5$) and the observation that

$$\overline{162}+\overline{243}+\overline{351}+\overline{174}+\overline{675}=\overline{1(6+4)(2-7)}+\overline{135}+\overline{24(3+1)}+\overline{67(5+1)}$$

shows that its length is at most 4, and since type ($VII\,4\beta$) has 4 blades, $N(C, 7, 3) = 4$.

Some condition on the ground field of V is required to get the classification given by Schouten. In $\Lambda^3 V$ where dim $V = 6$ and the ground field is the reals there is an extra orbit with

$$X_0 = \overline{123} + \overline{456} - \tfrac{1}{2}\overline{(1+4)(2+5)(3+6)}$$

as a representative. That X_0 is not in the orbits listed follows from the fact that $x \wedge X_0$ is never decomposable for non-zero $x \in V$, (this is easily checked using the plücker relations). For the types listed when the rank of X is at most 6 it is clear that there always is a non-zero x for which $x \wedge X$ is decomposable.

References

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2. J. A. Schouten, *Klassifizierung der alternierenden Gröszen Dritten Grades in 7 Dimensionen.* Cir. Mat. di Palermo, vol. **55**, 1931, (137–156).

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