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Cyclic and rotational hybrid triple systems. (English summary)

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A cyclic triple and a transitive triple are the digraph on the vertex set $\{a, b, c\}$ with the arc set $\{(a, b), (b, c), (c, a)\}$ and the arc set $\{(a, b), (b, c), (a, c)\}$, respectively. A c -hybrid triple system of order v , denoted c -HTS(v), is an arc-disjoint partition of the complete symmetric digraph on v vertices into c cyclic triples and $t = v(v-1)/3 - c$ transitive triples. A c -HTS(v) is cyclic if it admits an automorphism consisting of a single cycle of length v . A c -HTS(v) is rotational if it admits an automorphism consisting of a fixed point and a cycle of length $v-1$.

Employing direct constructions, the authors show that a cyclic c -HTS(v) exists if and only if (i) $v \equiv 1 \pmod{6}$ and $t \in \{0, 2v, 3v, 4v, \dots, v(v-1)/3\}$, or (ii) $v \equiv 4 \pmod{12}$ and $t \in \{v, 2v, 3v, \dots, v(v-1)/3\}$, or (iii) $v \equiv 3 \pmod{6}$, $v \neq 9$, and $t \in \{0, 2v, 3v, 4v, \dots, v(v-3)/3\}$, or (iv) $v \equiv 0 \pmod{12}$ and $t \in \{v, 2v, 3v, \dots, v(v-3)/3\}$ where $c = v(v-1)/3 - t$. They also show that a rotational c -HTS(v) exists if and only if (a) $v = 10$ and $t \in \{9, 18, 27\}$, or (b) $v \equiv 1 \pmod{3}$, $v \neq 10$, and $t \in \{0, (v-1), 2(v-1), 3(v-1), \dots, (v-1)^2/3\}$, or (c) $v \equiv 0 \pmod{6}$ and $t \in \{(v-1), 2(v-1), 3(v-1), \dots, v(v-1)/3\}$, or (d) $v \equiv 3 \pmod{6}$ and $t \in \{0, (v-1), 2(v-1), 3(v-1), \dots, v(v-1)/3\}$, where $c = v(v-1)/3 - t$.

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