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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 digraphs 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-disjont 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 $t\in\{0,2v,3v,4v,\cdots,v(v-1)/3\}$, or (ii) $v\equiv 4 \pmod{12}$ and $t\in\{v,2v,3v,\cdots,v(v-1)/3\}$, or (iii) $v\equiv 3 \pmod 6$, $v\neq 9$, and $t\in\{0,2v,3v,4v,\cdots,v(v-3)/3\}$, or (iv) $v\equiv 0 \pmod{12}$ and $t\in\{v,2v,3v,\cdots,v(v-3)/3\}$, where $c=v(v-1)/3-t$.

They also show that a rotational c-HTS(v) exists if and only if (i) $v=10$ and $t\in\{9,18,27\}$, or (ii) $v\equiv 1 \pmod 3$, $v\neq 10$, and $t\in\{0,(v-1),2(v-1),3(v-1),\cdots,(v-1)^2/3\}$, or (iii) $v\equiv 0 \pmod 6$ and $t\in\{(v-1),2(v-1),3(v-1),\cdots,v(v-1)/3\}$, or (iv) $v\equiv 3 \pmod 6$ and $t\in\{0,(v-1),2(v-1),3(v-1),\cdots,v(v-1)/3\}$, where $c=v(v-1)/3-t$.

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