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On sequential countably compact topological semigroups

In our report all topological spaces will be assumed to be Hausdorff. We shall follow the terminology of [1, 2, 3]. A topological space S that is algebraically semigroup with a continuous semigroup operation is called a *topological semigroup*. A topological space X is called *countably compact* if any countable open cover of X contains a finite subcover [3]. A topological space X is called *sequential* if each non-closed subset A of X contains a sequence of points $\{x_n\}_{n\in N}$ that converges to some point of $x \in X \setminus A$ [3].

Theorem 1 *The bicyclic semigroup does not embed into a sequential countably compact topological semigroup.*

Theorem 2 *Let S be a countably compact topological semigroup which contains the bicyclic semigroup $\mathcal{C}(p,q)$ as a dense subsemigroup. Let $e \in cl_S(E(\mathcal{C}) \setminus E(\mathcal{C})$. Then*

(i) the map $h\colon \mathcal{C}(p,q) \to S$ defined by the formula $h(x) = e \cdot x$ is a continuous homomorphism;

(ii) e is the identity in $S \setminus \mathcal{C}(p,q)$;

(iii) the map $h\colon S \to S$ defined by the formula $h(x) = e\cdot x$ is a continuous homomorphism;

(iv) $h(\mathcal{C}(p,q))$ is a dense subgroup of $S \setminus \mathcal{C}(p,q)$, moreover $h(\mathcal{C}(p,q))$ is algebraically isomorphic to the additive group of integers;

(v) $S \setminus \mathcal{C}(p,q)$ is a commutative subsemigroup in S.

Theorem 3 *The closure of a subgroup in a countably compact sequential topological semigroup is a subgroup.*

Theorem 4 *The inversion on a Clifford countably compact topological semigroup is sequentially continuous.*

Theorem 5 *A T_3-sequential countably compact topological semigroup S is completely simple if and only if S is topologically isomorphic to a topological paragroup $[X, G, Y]_\sigma$ for some T_3-sequential countably compact topological spaces X and Y and sequential countably compact topological group G.*

[1] J. H. Carruth, J. A. Hildebrant and R. J. Koch, *The Theory of Topological Semigroups*, Vol. I and II, Marcel Dekker, Inc., New York and Basel, 1983 and 1986.

[2] A. H. Clifford and G. B. Preston, *The Algebraic Theory of Semigroups*, Vol. I and II., Amer. Math. Soc. Surveys 7, Providence, R.I., 1961 and 1967.

[3] R. Engelking, *General Topology*, 2nd ed., Heldermann, Berlin, 1989.