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HOMOMORPHISM NEAR-FIELD SPACE OVER A NEAR-FIELD

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ABSTRACT

In depth study of near-rings, near-fields, various types of δ - near-rings is motivated to extend the feature of near-field spaces over near-rings as well as near-fields and by consideration of the system generated by the endomorphisms of a (not necessarily commutative) near-field space. Such endomorphism near-field spaces also furnish the motivation for the concept of a distributively generated (d.g.) near-field space. Although Dr N V Nagendram as author, d.g. near-field spaces have been extensively studied, little is known about the structure of endomorphism near-field spaces. In this paper results are presented which enable one to give the elements of the endomorphism near-field space of a near-field space over a near-field. Also some results relating to the right sub near-field space structure of an endomorphism near-field space are presented. These concepts are applied to present a detailed picture of the properties of the endomorphism near-field space of (S_n, +).

Keywords: *sub near-field space, near-field space, endomorphism sub near-field space, endomorphism semi simple near-field space, endomorphism near-field space.*

2000 Mathematics Subject Classification: *43A10, 46B28, 46H25, 46H99, 46L10, 46M20.*

SECTION-1: PRELIMINARIES

A near-field space is a triple (N, +, .) such that (N , +) is a group, if (N, .) is a semi group, and "." Is left distributive over "+" i.e. $w(x + z) = wx + wz$ for each w, x, y, z $\in$ N. A near-field space N is d.g. if there exists T $\subset$ N such that (T, .) is a semi sub near-field space of (N, .) each element of T is right distributive and T is an additive generating space for (N, +). The near-field space generated additively by all the endomorphism of a (not necessarily commutative) sub near-field space (G, +) is d.g. T being the space of endomorphisms. Such a near-field space will be called an endomorphism near-field space and will be denoted by E(G).

Dr N V Nagendram has shown that the near-field space generated by all the inner automorphisms of a finite simple, non-commutative, sub near-field space (G, +) is E(G). In fact, this near-field space generated by the inner automorphisms consists of all the mappings of G into G which leave 0 fixed and also has given a necessary and sufficient condition that the near-field space generated by the inner automorphisms of a sub near-field space of a near-field space be a near-field space. However, the more general endomorphism near-field space has not been studied.

If α is an endomorphism of (G, +) and g $\in$ G, the image of g under α is denoted by $g\alpha$. Addition of functions on G is done point-wise and multiplication of such functions is composition.

Definition 1.1: A sub near-field space H of the near-field space N is a N-sub near-field space over a near-field if HN $\subset$ H. The radical sub near-field space J(N) is the intersection of the right sub near-field spaces of N which are maximal N-sub near-field spaces over a near-field.

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SECTION-2: PROPERTIES OF E(N)

Theorem 2.1: Let e be an idempotent in the near-field space N. Then each r $\in$ N has two unique decompositions r = (r – er) + er = er + (- er + r). Thus N = B_e+ M_e = M_e + B_e where B_e = { r – er / r $\in$ N} = { t $\in$ N / et = 0, M_e = {er / r $\in$ N} and $B_e \cap M_e$ = 0.

Theorem 2.2: B_e is a right sub near-field space of a near-field space N. If 0r = 0 $\forall$ r $\in$ R, then B_e is also a sub near-field space of a near-field space N over a near-field. M_e is a sub near-field space of a near-field space N over a near-field.

Theorem 2.3: Let N be a near-field space such that (N, +) is generated by {r_γ / $\gamma \in \Gamma$, an index space}. Then B_e is the normal sub near-field space generated by {r_γ - e r_γ / $\gamma \in \Gamma$} and M_e is the sub near-field space generated by {e r_γ / $\gamma \in \Gamma$}.

Lemma 2.4: Let N be d.g. and e right distributive. Then M_e is d.g.

Theorem 2.5: Let T be a non-empty sub near-field space of the near-field space N. let K = {$\alpha \in$ E(N) / Tα = 0}. if K is non-empty, K is a right sub near-field space in E(N).

SECTION-3: THE ELEMENTS OF E(S_N, +).

Let (S, +) designate the non-abelian sub near-field space of order six with addition as given in table below. Here the elements of E(S) will be displayed.

+	0	*a*	*b*	*c*	*d*	*e*
0	0	*a*	*b*	*c*	*d*	*e*
a	*a*	0	*e*	*d*	*c*	*b*
b	*b*	*d*	0	*e*	*a*	*c*
c	*c*	*e*	*d*	0	*b*	*a*
d	*d*	*b*	*c*	*a*	*e*	0
e	*e*	*c*	*a*	*b*	0	*d*

Since S is finite each element of E(S) can be expressed as a finite sum of endomorphisms of S. It follows that each function in E(S) maps 0 to 0. Each function in E(S) can be represented by a 5-tuple. The first co-ordinate being the image of a, the second the image of b etc. For instance, the 5-tuple (abcde) represents the identity function.

Since the only non-trivial normal sub near-field space of S is {0, d, e} and since the only automorphisms of S are the inner automorphisms, it follows that there are exactly ten endomorphisms of S. Among these is the idempotent endomorphism (aaaoo). Using the idempotent α = (aaa00) to determine the elements of E(S). Of course, the set of endomorphisms is our generating set. The endomorphisms and their decompositions are given in table as below.

M_α = {(xxx00) / x $\in$ S} while A′ the sub near-field space generated by (t_γ - at_γ) is {(00000), (0dede), (0eded)}. It is clear that A′ is not normal sub near-field space (aaa00) + (0eded) – (aaa00) = (odeed).

t_γ	at_γ	$t_\gamma - at_\gamma$
(00000)	(00000)	(00000)
(*aaa*00)	(*aaa*00)	(00000)
(*bbb*00)	(*bbb*00)	(00000)
(*ccc*00)	(*ccc*00)	(00000)
(*abcde*)	(*aaa*00)	(0*dede*)
(*acbde*)	(*aaa*00)	(0*eded*)
(*cbaed*)	(*ccc*00)	(0*eded*)
(*baced*)	(*bbb*00)	(0*eded*)
(*cabde*)	(*ccc*00)	(0*dede*)
(*bcade*)	(*bbb*00)	(0*dede*)

The sub near-field space Mα is d.g. it is also noted that (M_α, +) $\cong$ (S, +). The near-field space generated by (0de00) has the null multiplication every product is (00000) and thus is a near-field space over a near-field.

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SECTION-4: RESULTS ON THE SUB NEAR-FIELD SPACE STRUCTURES OF E(S)

In this section the right (or left or two sided) sub near-field spaces of E(S) and the radical sub near-field space of E(S) will be determined.

We start with the observation that the sub near-field spaces over a near-field of order two in E(S) are non unique sylow sub near-field spaces over a near-field. So one of them is normal sub near-field space and there are no right (or left or two sided) sub near-field spaces of order two.

An application yields the annihilating right sub near-field spaces as given in table as below:

$T=\{c,d,e\}$	$I_1(3)=\{(de000)\}$
$T=\{b,d,e\|$	$I_2(3)=\{(d0e00)\}$
$T=\{a,d,e\}$	$I_1(3)=\{(0de00)\}$
$T=\{a,b,c\}$	$I_1(3)=\{(000d\ e)\}$
$T=\{c\}$	$I_1(9)=I_3(3)\oplus I_4(3)$
$T=\{b\}$	$I_2(9)=I_2(3)\oplus I_4(3)$
$T=\{a\}$	$I_3(9)=I_3(3)\oplus I_4(3)$
$T=\{d,e\}$	$I(18)=\{\lambda\in E(S)/2\lambda=(00000)\ or\ \lambda^2=(00000)$

Proposition 4.1: In E(S), the elements of order two of the form (xxx00) form a multiplicative sub near-field space M.

Proposition 4.2: In E(S) the conjugate of an element of order two of the form (xxx00) by (abc00) is in M.

Proposition 4.3: A proper right (or left or two sided) sub near-field space of E(S) containing an element of order two consists of functions which map the pair de to 00.

Note 4.4: I (18) contains all functions sending de to 00.

Proposition 4.5: Let L be a left sub near-field space of E(S), let $\lambda \in$ L with $|\lambda|$ = 3 and let λ map the pair to either de or ed. Then (de000), (d0e00)$\in$ L. i.e. J(E(S)) $\subset$ L.

Note 4.6: Therefore the radical is the unique left sub near-field space of order one.

SECTION-5: COMMENTS

The only elements of I(18) which are right distributive in I(18) are the four endomorphisms contained in I(18). These four elements do not constitute an additive generating set for I(18). No other elements of I(18) is right distributive since all others, except (de000) and (ed000) fail to distribute over the sum (aaa00) + (bbb00) and (de000) and (ed000) fail to distribute over the sum of (abc00) + (abc00). Thus I(18) is not d. g. SO we have a new example showing that a sub near-field space over a near-field of a d. g. near-field need not be d. g. The only other example appearing in the literature is that noted in that the sub near-field space is not a right sub near-field space over a near-field.

The near-field space E(N) contains an idempotent element e such that (M_e, +) ≅ (N, +). In sub sequent articles of advanced research, further properties of E(N) will be explored and additional examples will be presented.

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