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On decomposition of weak continuity

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ABSTRACT. In this paper, the notions of locally μ-regular closed sets, $\widehat{\mu}$-t-sets, $\widehat{\mu}$-B-sets have been introduced. Using these concepts, the decomposition of some weak forms of continuity have been studied.

1. INTRODUCTION

The notion of decompositions of continuity was first introduced by Tong [18, 19] by defining $\mathcal{A}$-sets and $\mathcal{B}$-sets. The decomposition of continuity and some of its weaker forms have been further studied by different mathematicians like Ganster and Reilly [9], Yalvac [20], Hatir and Noiri [10, 11], Przemski [15], Noiri and Sayed [14], Dontchev and Przemski [6], Erguang and Pengfei [8], Noiri, Rajamni and Sundaram [13] and many others. Since then the notion of decompositions of continuity is one of the most important area of research.

In the last few years, different forms of open sets have been studied. Recently, a significant contribution to the theory of generalized open sets was extended by A. Császár. Especially, the author defined some basic operators on generalized topological spaces. It is observed that a large number of papers is devoted to the study of generalized open like sets of a topological space, containing the class of open sets and possessing properties more or less similar to those of open sets.

We recall some notions defined in [3]. Let X be a non-empty set, $expX$ denotes the power set of X. We call a class $\mu \subseteq expX$ a generalized topology [3], (briefly, GT) if $\varnothing \in \mu$ and union of elements of μ belongs to μ. A set X, with a GT μ on it is said to be a generalized topological space (briefly, GTS) and is denoted by (X, μ). For a GTS (X, μ), the elements of μ are called μ-open sets and the complement of μ-open sets are called μ-closed sets. For $A \subseteq X$, we denote by $c_\mu(A)$ the intersection of all μ-closed sets containing A, i.e., the smallest μ-closed set containing A; and by $i_\mu(A)$ the union of all μ-open sets contained in A, i.e., the largest μ-open set contained in A (see [3, 4]). It is easy to observe that i_μ and c_μ are idempotent and monotonic, where $\gamma : expX \to expX$ is said to be idempotent iff $A \subseteq B \subseteq X$ implies $\gamma(\gamma(A)) = \gamma(A)$ and monotonic iff $\gamma(A) \subseteq \gamma(B)$. It is also well known from [4, 5] that if μ is a GT on X and $A \subseteq X$, $x \in X$, then $x \in c_\mu(A)$ iff $x \in M \in \mu \Rightarrow M \cap A \neq \varnothing$ and $c_\mu(X \setminus A) = X \setminus i_\mu(A)$.

Throughout the paper (X, τ) and (Y, σ) will represent topological spaces and μ is a GT on the topological space (X, τ). A subset A of a topological space (X, τ) is called regular open if $int(cl(A)) = A$. The complement of a regular open set is called regular closed. The collection of all regular open sets in a topological space is denoted by $RO(X)$.

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2. Locally μ-regular closed sets and decomposition of μ-continuity

Definition 2.1. Let μ be a GT on a topological space (X, τ). A subset A of X is called locally μ-regular closed if $A = U \cap F$ where $U \in RO(X)$ and F is μ-closed.

Remark 2.1. Let μ be a GT on a topological space (X, τ). Then
(i) A is locally μ-regular closed if and only if $X \setminus A$ is the union of a regular closed set and a μ-open set.
(ii) Every regular open set as well as a μ-closed set is locally μ-regular closed.
(iii) Finite intersection of locally regular μ-closed sets is locally μ-regular closed.

Example 2.1. (a) Let $X = \{a, b, c\}$, $\mu = \{\varnothing, \{a\}, \{a, b\}, \{a, c\}, X\}$ and $\tau = \{\varnothing, \{a\}, \{b\}, \{a, b\}, \{a, c\}, X\}$. Then μ is a GT on the topological space (X, τ). Now it is easy to check that $\{a\}$ is open but not locally μ-regular closed and $\{c\}$ is locally μ-regular closed but not open. It is also to observe that $\{b, c\}$ is locally μ-regular closed but not regular open. Again $\{a, c\}$ is locally μ-regular closed but not μ-closed.

(b) Let $X = \{a, b, c\}$, and $\tau = \{\varnothing, \{a\}, \{b\}, \{a, b\}, \{a, c\}, X\}$. If we consider the GT $\mu = \{\varnothing, \{b, c\}, \{a, c\}, X\}$ on the topological space (X, τ), then $\{a, c\}$ is locally μ-regular closed but not μ-closed. It is easy to verify that $\{a\}$ and $\{b\}$ are two locally μ-regular closed set but their union $\{a, b\}$ is not so.

Definition 2.2. Let μ be a GT on a topological space (X, τ). A subset A of X is called locally μ-closed [17] if $A = U \cap F$ where $U \in \tau$ and F is μ-closed.

Remark 2.2. Every locally μ-regular closed set is locally μ-closed but the converse is false as shown by the next example.

Example 2.2. Let $X = \{a, b, c, d\}$, $\tau = \{\varnothing, \{a, b\}, \{c, d\}, \{a, c, d\}, X\}$ and $\mu = \{\varnothing, \{a, b\}, \{a, c\}, \{a, b, c\}\}$. Then μ is a GT on the topological space (X, τ). It can be checked that $\{a, c, d\}$ is a locally μ-closed set but not locally μ-regular closed.

Theorem 2.1. *Let μ be a GT on a topological space (X, τ). Then a subset A of X is locally μ-regular closed if and only if there exists a regular open set $U \subseteqq X$ such that $A = U \cap c_\mu(A)$.*

Proof. Let A be a locally μ-regular closed subset of X. Then $A = U \cap F$ where U is regular open in X and F is μ-closed. Thus $A \subseteqq U$ and $A \subseteqq F$. Then $A \subseteqq c_\mu(A) \subseteqq c_\mu(F) = F$. Therefore, $A \subseteqq U \cap c_\mu(A) \subseteqq U \cap c_\mu(F) = U \cap F = A$. Thus $A = U \cap c_\mu(A)$. Conversely, since $c_\mu(A)$ is μ-closed, A is locally μ-regular closed. □

Theorem 2.2. *Let μ be a GT on a topological space (X, τ). If $A \subseteqq B \subseteqq X$ and B is locally μ-regular closed, then there exists a locally μ-regular closed set C such that $A \subseteqq C \subseteqq B$.*

Proof. As B is locally μ-regular closed by Theorem 2.1, $B = U \cap c_\mu(B)$ where U is regular open. Then $A \subseteqq B \subseteqq U$. So $A \subseteqq U \cap c_\mu(A) = C$ (say). Then C is locally μ-regular closed and $A \subseteqq C \subseteqq B$. □

Proposition 2.1. *Let μ be a GT on a topological space (X, τ) such that $RO(X) \subseteqq \mu$. If A is locally μ-regular closed then*
(i) $c_\mu(A) \setminus A$ is μ-closed.
(ii) $A \cup [X \setminus c_\mu(A)]$ is μ-open.
(iii) $A \subseteqq i_\mu[A \cup (X \setminus c_\mu(A))]$.

Proof. (i) Let A be a locally μ-regular closed subset of X. Thus by Theorem 2.1, there exists a regular open set U such that $A = U \cap c_\mu(A)$. Now $c_\mu(A) \setminus A = c_\mu(A) \setminus [U \cap c_\mu(A)] =$

$c_\mu(A) \cap [X \setminus (U \cap c_\mu(A))] = c_\mu(A) \cap [(X \setminus U) \cup (X \setminus c_\mu(A))] = [c_\mu(A) \cap (X \setminus U)] \cup [c_\mu(A) \cap (X \setminus c_\mu(A))] = c_\mu(A) \cap (X \setminus U)$ which is a μ-closed set.
(ii) Since $c_\mu(A) \setminus A$ is μ-closed, then $X \setminus (c_\mu(A) \setminus A)$ is μ-open and $X \setminus (c_\mu(A) \setminus A) = X \setminus (c_\mu(A) \cap (X \setminus A)) = A \cup (X \setminus c_\mu(A))$.
(iii) From (ii), it follows that, $A \subseteq [A \cup (X \setminus c_\mu(A))] = i_\mu[A \cup (X \setminus c_\mu(A))]$. □

That $RO(X) \subseteq \mu$ is necessary in the above theorem is shown by the next example.

Example 2.3. Consider $X = \{a, b, c\}$ with the topology $\tau = \{X, \varnothing, \{a\}, \{b\}, \{a, b\}\}$. Consider the GT $\mu = \{\varnothing, \{a\}, \{a, c\}\}$ on the space (X, τ). Let $A = \{b\}$. Then $c_\mu(A) \setminus A = \{b\} \setminus \{b\} = \varnothing$ which is not a μ-closed set, but A is a locally μ-regular closed set in X.

Definition 2.3. [16] Let μ be a GT on a topological space (X, τ). Then $A \subseteq X$ is called a regular generalized μ-closed set (or simply a $r\mu g$-closed set) if $c_\mu(A) \subseteq U$ whenever $A \subseteq U \in RO(X)$. The complement of a $r\mu g$-closed set is called a regular generalized μ-open (or simply a $r\mu g$-open) set.

Theorem 2.3. *Let μ be a GT on a topological space (X, τ). Then A is μ-closed if and only if it is $r\mu g$-closed and locally μ-regular closed.*

Proof. Suppose that A is a μ-closed set in X. Let $A \subseteq U$ where U is regular open in X. Then $c_\mu(A) = A \subseteq U$. Thus A is $r\mu g$-closed. Since A is μ-closed it is locally μ-regular closed (by Remark 2.1).

Conversely suppose that A is $r\mu g$-closed and locally μ-regular closed. Thus $A = U \cap F$, where $U \in RO(X)$ and F is μ-closed. So $A \subseteq U$ and $A \subseteq F$. So by hypothesis $c_\mu(A) \subseteq U$ and $c_\mu(A) \subseteq c_\mu(F) = F$. Thus $c_\mu(A) \subseteq U \cap F = A$. Thus A is μ-closed. □

Example 2.4. Let $X = \{a, b, c\}$, $\tau = \{\varnothing, \{a\}, \{b\}, \{a, b\}, X\}$ and $\mu = \{\varnothing, \{a, c\}, \{a, b\}, X\}$. Then (X, τ) is a topological space and μ is a GT on X. It is easy to show that $\{a\}$ is locally μ-regular closed but not $r\mu g$-closed. It can also be shown that $\{a, c\}$ is not locally μ-regular closed but $r\mu g$-closed.

Definition 2.4. Let μ be a GT on a topological space (X, τ). Then a subset A of X is said to be (i) $\widehat{\mu}$-t-set if $int(cl(A)) = int(cl(c_\mu(A)))$;
(ii) $\widehat{\mu}$-B-set if $A = U \cap V$, $U \in RO(X)$, V is a $\widehat{\mu}$-t-set;
(iii) μ''-open if $A \subseteq int(cl(c_\mu(A)))$.

Proposition 2.2. *Let μ be a GT on a topological space (X, τ). Then*
(i) If A is a μ-closed set then it is a $\widehat{\mu}$-t-set.
(ii) If A is a $\widehat{\mu}$-t-set then it is also a $\widehat{\mu}$-B-set.
(iii) Every locally μ-regular closed set is a $\widehat{\mu}$-B-set.

Proof. (i) Let A be a μ-closed set. Then $A = c_\mu(A)$. Thus $int(cl(A)) = int(cl(c_\mu(A)))$. Therefore A is a $\widehat{\mu}$-t-set.
(ii) Let A be a $\widehat{\mu}$-t-set. Then $A = X \cap A$. The rest follows from the definition of a $\widehat{\mu}$-B-set.
(iii) Let A be a locally μ-regular closed subset of X. Then $A = U \cap F$, where U is regular open in X and F is μ-closed. Then by (ii), F is a $\widehat{\mu}$-t-set and hence A is a $\widehat{\mu}$-B-set. □

Example 2.5. (a) Let $X = \{a, b, c\}$, $\tau = \{\varnothing, \{a\}, \{b\}, \{a, b\}, X\}$ and $\mu = \{\varnothing, \{a, b\}, \{a, c\}, X\}$. Then μ is a GT on the topological space (X, τ). It can be checked that $\{a, b\}$ is a $\widehat{\mu}$-t-set which is not μ-closed. We observe that here $\{b\}$ and $\{c\}$ are two $\widehat{\mu}$-t-sets but their union is not so. It can also be verified that $\{a\}$ is a $\widehat{\mu}$-B-set which is not a $\widehat{\mu}$-t-set.

(b) Let $X = \{a, b, c\}$, $\tau = \{\varnothing, \{a\}, \{b, c\}, X\}$ and $\mu = \{\varnothing, \{c\}\}$. Then μ is a GT on the topological space (X, τ). It can be checked that $\{a, b\}$ and $\{a, c\}$ are two $\widehat{\mu}$-t-sets but their intersection is not so.

(c) Let $X = \{a, b, c, d\}$, $\tau = \{\varnothing, \{a\}, \{c\}, \{a, b\}, \{a, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, X\}$ and $\mu = \{\varnothing, \{a\}, \{a, b\}, \{a, c\}, \{a, b, c\}, X\}$. Then μ is a GT on the topological space (X, τ). It can be checked that $\{c\}$ is a $\widehat{\mu}$-t-set which is not locally μ-regular closed and $\{a, b\}$ is locally μ-regular closed which is not a $\widehat{\mu}$-t-set. Also $\{c\}$ is a $\widehat{\mu}$-B-set but not locally μ-regular closed.

(d) Let $X = \{a, b, c, d\}$, $\mu = \{\varnothing, \{a, b\}, \{a, c\}, \{b, d\}, \{a, b, c\}, \{a, b, d\}\}$ and $\tau = \{\varnothing, \{b\}, \{b, c\}, \{b, d\}, \{b, c, d\}, X\}$. Then μ is a GT on the topological space (X, τ). It can be checked that $\{a, b, c\}$ is a $\widehat{\mu}$-B-set but not a locally μ-closed set. Also we observe that $\{a\}$ and $\{d\}$ are two $\widehat{\mu}$-B-sets but their union is not so.

(e) Let $X = \{a, b, c\}$, $\mu = \{\varnothing, \{b\}, \{c\}, \{b, c\}\}$ and $\tau = \{\varnothing, \{a\}, \{a, b\}, X\}$. Then μ is a GT on the topological space (X, τ). It can be checked that $\{b\}$ is not a $\widehat{\mu}$-B-set but a locally μ-closed set.

Proposition 2.3. *Let μ be a GT on a topological space (X, τ). Then A is regular open if and only if A is μ''-open and a $\widehat{\mu}$-B-set.*

Proof. Let A be regular open. Then $A = int(cl(A)) \subseteqq int(cl(c_\mu(A)))$ and hence A is μ''-open. Also $A = A \cap X$ where A is regular open and X is a $\widehat{\mu}$-t-set. Hence A is a $\widehat{\mu}$-B-set.

Conversely, since A is a $\widehat{\mu}$-B-set, $A = U \cap V$, where U is regular open in X and V is a $\widehat{\mu}$-t-set. As A is μ''-open, $A \subseteqq int(cl(c_\mu(A))) \subseteqq int(cl(c_\mu(U \cap V))) \subseteqq int[cl(c_\mu(U)) \cap cl(c_\mu(V))] = int(cl(c_\mu(U))) \cap int(cl(V))$. Hence $A = U \cap V = (U \cap V) \cap U \subseteqq int(cl(c_\mu(U)) \cap int(cl(V))) \cap U = int(cl(c_\mu(U)) \cap U) \cap int(cl(V)) = U \cap int(cl(V))$. Thus A is a regular open set. □

Example 2.6. Consider Example 2.1(a). It can be shown that $\{a, b\}$ is a μ''-open set but not a $\widehat{\mu}$-B-set. Also $\{c\}$ is a $\widehat{\mu}$-B-set but not μ''-open.

Definition 2.5. Let μ be a GT on a topological space (X, τ). Then a function $f : (X, \tau) \to (Y, \sigma)$ is said to be $r\mu g$-continuous (resp. contra μ-lrc-continuous) if $f^{-1}(F)$ is $r\mu g$-closed (resp. locally μ-regular closed) for each regular closed set F of (Y, σ).

Definition 2.6. Let μ be a GT on a topological space (X, τ). Then a function $f : (X, \tau) \to (Y, \sigma)$ is said to be weakly (μ, σ)-continuous if for each $x \in X$ and for each regular open set V of Y containing $f(x)$, there exists $U \in \mu$ containing x such that $f(U) \subseteqq V$.

Theorem 2.4. *Let μ be a GT on a topological space (X, τ). Then for a function $f : (X, \tau) \to (Y, \sigma)$ the followings are equivalent :*
(i) f is weakly (μ, σ)-continuous;
(ii) for every regular open set V of Y, $f^{-1}(V)$ is μ-open in X;
(iii) for every regular closed set F of Y, $f^{-1}(F)$ is μ-closed in X.

Proof. (i) ⇒ (ii): Let V be a regular open set in Y and $x \in f^{-1}(V)$. Then there exists a μ-open set U in X containing x such that $f(U) \subseteqq V$. Then $x \in U \subseteqq f^{-1}(V)$. Thus $f^{-1}(V)$ is μ-open.

(ii) ⇒ (iii): Let F be a regular closed subset of Y. Then by (ii), $f^{-1}(Y \setminus F) = X \setminus f^{-1}(F)$ is μ-open. Thus $f^{-1}(F)$ is μ-closed.

(iii) ⇒ (i): Let V be a regular open set in Y containing $f(x)$. Then by (iii), $f^{-1}(Y \setminus V) = X \setminus f^{-1}(V)$ is a μ-closed set in X. Thus $f^{-1}(V)$ is a μ-open set containing x. Thus there exists a μ-open set U containing x such that $x \in U \subseteqq f^{-1}(V)$. Thus $f(U) \subseteqq V$. □

Theorem 2.5. *Let μ be a GT on a topological space (X, τ). Then a function $f : (X, \tau) \to (Y, \sigma)$ is weakly (μ, σ)-continuous if and only if it is $r\mu g$-continuous and contra μ-lrc-continuous.*

Proof. This follows from Theorem 2.4 and Theorem 2.3. □

Example 2.7. (a) Let $X = Y = \{a, b, c\}$, $\tau = \{\varnothing, \{a\}, \{b\}, \{a, b\}, X\}$, $\sigma = \{\varnothing, \{b\}, \{a, c\}, Y\}$, $\mu = \{\varnothing, \{c\}, \{a, b\}, \{a, c\}, X\}$. It can be checked that the identity function $f : (X, \tau) \to (Y, \sigma)$ is $r\mu g$-continuous but not contra μ-lrc-continuous.

(b) Let $X = Y = \{a, b, c\}$, $\tau = \{\varnothing, \{a\}, \{b\}, \{a, b\}, X\}$, $\sigma = \{\varnothing, \{a\}, \{b\}, \{a, b\}, \{b, c\}, Y\}$, $\mu = \{\varnothing, \{c\}, \{a, b\}, \{a, c\}, X\}$. It can be checked that the identity function $f : (X, \tau) \to (Y, \sigma)$ is contra μ-lrc-continuous but not $r\mu g$-continuous.

Definition 2.7. *A function $f : (X, \tau) \to (Y, \sigma)$ is said to be contra R map* [7] *if $f^{-1}(F)$ is regular open in X for each regular closed set F of (Y, σ).*

Theorem 2.6. *Let μ be a GT on a topological space (X, τ). Then a contra R map $f : (X, \tau) \to (Y, \sigma)$ is weakly (μ, σ)-continuous if and only if it is $r\mu g$-continuous.*

Proof. Let f be a contra R map and $r\mu g$-continuous. Let F be a regular closed set in (Y, σ). Then $f^{-1}(F)$ is regular open in X (as f is R map). Thus $f^{-1}(F)$ is locally μ-regular closed in X. Since f is $r\mu g$-continuous, $f^{-1}(F)$ is $r\mu g$-closed. Thus by Theorem 2.3, $f^{-1}(F)$ is μ-closed, showing f to be weakly (μ, σ)-continuous.

Converse part is obvious as every μ-closed set is $r\mu g$-closed. □

Definition 2.8. Let μ be a GT on a topological space (X, τ). A mapping $f : (X, \tau) \to (Y, \sigma)$ is said to be contra $r\mu g$-continuous (resp. contra $r\mu$-continuous, μ_r-lc-continuous) if $f^{-1}(V)$ is $r\mu g$-closed (resp. μ-closed, locally μ-regular closed) in X for each regular open set V of Y.

Theorem 2.7. *Let μ be a GT on a topological space (X, τ). A mapping $f : (X, \tau) \to (Y, \sigma)$ is contra $r\mu$-continuous if and only if it is μ_r-lc-continuous and contra $r\mu g$-continuous.*

Proof. Follows from Theorem 2.3. □

Example 2.8. Let $X = \{a, b, c\}$, $\tau = \{X, \varnothing, \{a\}, \{b\}, \{a, b\}, \{a, c\}\}$, $\mu = \{\varnothing, \{a\}, \{a, b\}, \{a, c\}, X\}$. Then the mapping $f : (X, \tau) \to (X, \tau)$ defined by $f(a) = c$, $f(b) = b$, $f(c) = c$ is not contra $r\mu g$-continuous but μ_r-lc-continuous. Also the mapping $h : (X, \tau) \to (X, \tau)$ defined by $h(a) = a$, $h(b) = c$, $h(c) = b$ is contra $r\mu g$-continuous but not μ_r-lc-continuous.

Definition 2.9. Let μ be a GT on a topological space (X, τ). A mapping $f : (X, \tau) \to (Y, \sigma)$ is said to be μ''-continuous (resp. $\widehat{\mu}$-B-continuous) if for each regular open set V of Y, $f^{-1}(V)$ is μ''-open (resp. a $\widehat{\mu}$-B-set).

Definition 2.10. A mapping $f : (X, \tau) \to (Y, \sigma)$ is β-continuous (simply βC) [1] or an R map [2, 12] if $f^{-1}(V) \in RO(X)$ for each $V \in RO(Y)$.

Theorem 2.8. *Let μ be a GT on a topological space (X, τ). A mapping $f : (X, \tau) \to (Y, \sigma)$ is β-continuous or an R map if and only if it is μ''-continuous and $\widehat{\mu}$-B-continuous on X.*

Proof. Follows from Proposition 2.3. □

Example 2.9. (a) Let $X = Y = \{a, b, c, d\}$, $\mu = \{\varnothing, \{a\}, \{a, b\}, \{a, c\}, \{a, b, c\}\}$, $\tau = \{\varnothing, \{a\}, \{a, b\}, \{c, d\}, \{a, c, d\}, X\}$, $\sigma = \{\varnothing, \{a\}, \{b, d\}, \{a, c\}, \{a, d\}, \{a, b, d\}, \{a, c, d\}\}$. Then (X, τ) and (Y, σ) are two topological spaces. Consider the identity mapping $f : (X, \tau) \to (X, \sigma)$. It can be checked that f is not $\widehat{\mu}$-B-continuous but μ''-continuous.

(b) Let $X = \{a, b, c\}$, $\mu = \{\varnothing, \{a\}, \{a, b\}, \{a, c\}, X\}$, $\tau = \{\varnothing, \{a\}, \{b\}, \{a, b\}, \{a, c\}, X\}$. Then (X, τ) is a topological space. Consider the mapping $f : (X, \tau) \to (X, \tau)$ defined by $f(a) = c, f(b) = a$, $f(c) = b$. It can be checked that f is $\widehat{\mu}$-B-continuous but not μ''-continuous.

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REFERENCES

[1] Carnahan, D., *Some properties related to compactness in topological spaces*, Ph. D. Thesis, Univ. of Arkansas, 1974

[2] Chae, G. I., and Lee, D. W., *Feebly open sets and feeble continuty in topological space*, Ulsan Inst. Tech. Rep., **15** (1984), 367–371

[3] Császár, Á., *Generalized topology, generalized continuity*, Acta Math. Hungar., **96** (2002), 351–357

[4] Császár, Á., *Generalized open sets in generalized topologies*, Acta Math. Hungar., **106** (2005), 53–66

[5] Császár, Á., *δ- and θ-modifications of generalized topologies*, Acta Math. Hungar., **120**, No. 3, (2008), 275–279

[6] Dontchev, J. and Przemski, M., *On various decompositions of continuous and some weakly continuous functions*, Acta Math. Hungar., **71** (1996), 109–120

[7] Ekici, E., *Another form of contra continuity*, Kochi Jour. Math., **1** (2006), 21–29

[8] Erguang, Y. and Pengfei, Y., *On decomposition of $\mathcal{A}$ continuity*, Acta Math. Hungar., **110** (2006), 309–313

[9] Ganster, M. and Reilly, I. L., *A decomposition of continuity*, Acta Math. Hungar., **56** (1990), 299–301

[10] Hatir, E. and Noiri, T., *Decomposition of continuity and complete continuity*, Acta Math. Hungar., **113** (2006), 281–287

[11] Hatir, E., Noiri, T. and Yuksel, S., *A decomposition of continuity*, Acta Math Hungar., **70** (1996), 145–150

[12] Khwdr, F. H. and Noiri, T., *On θ-irrosolute functions*, Indian Jour. Math., **28** (1986), No. 3, 221–227

[13] Noiri, T., Rajamani, M. and Sundaram, P. *A decomposition of weaker forms of continuity*, Acta Math. Hungar., **93** (2001), No. 1-2, 109–114

[14] Noiri, T., and Sayed, O. R., *On decomposition of continuity*, Acta Math. Hungar., **110** (2006), 307–314

[15] Przemski, M., *A decomposition of continuity and α-continuity*, Acta Math. Hungar., **61** (1993), 93–98

[16] Roy, B., *Unification of almost regular, almost normal and mildly normal topological spaces*, Demonstratio Math., **XLV** (2012), No. 4, 963–974

[17] Roy, B. and Sen, R., *On a type of decomposition of continuity*, Afrika Math., **26** (2015), No. (1-2),153–158

[18] Tong, J., *On decmposition of continuity in topological spaces*, Acta Math. Hungar., **54** (1989), 51–55

[19] Tong, J., *Classification of weak continuities and decomposition of continuiy*, Internat. J. Math. Math. Sci., **51** (2004), 2755–2760

[20] Yalvac, T. H., *Decompositions of continuity*, Acta Math. Hungar., **64** (1994), 309–313

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