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On interpolative $\mathcal{R}$-Meir-Keeler contractions of rational forms

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Abstract. In this article, the notion of rational interpolative Meir-Keeler type contraction is discussed. The existence and uniqueness of a fixed point for interpolative Meir-Keeler contraction of rational Das-Gupta are investigated. The obtained results improve and generalize the existing results on the topic in the recent literature.

1. Introduction

In 1922, Banach [14] gave famous result so called Banach contraction principle. After that fixed point theory become one of the important research areas of mathematics. Banach fixed point theorem has many generalization in the literature. In 1968 Kannan [29] removed the continuity property and give a new variant. Another interesting contraction is the uniform contraction given by Meir and Keeler [43]. In 2018, Karapınar [30] enriched the concept of interpolation and establishing a new contraction known as interpolative Kannan type contraction. There are many articles on this direction; see e.g. [1–4, 7–13, 15, 16, 18, 20–22, 24, 25, 27, 31–40, 44, 47].

For the sake of the completeness, we remind the notion of Meir-Keeler contraction, as follows.

Definition 1.1. *[43] Let (X, d) be a complete metric space and $f : X \to X$ be a mapping. We say that f is a* Meir-Keeler contraction *on the space X, if for every $\varepsilon > 0$, there exists $\delta(\varepsilon) > 0$ such that*

$$\varepsilon \leq d(u, v) < \varepsilon + \delta \;\Rightarrow\; d(fu, fv) < \varepsilon, \tag{1}$$

for every $u, v \in X$.

Theorem 1.2. *[43] Let (X, d) be a complete metric space and $f : X \to X$ be a Meir-Keeler contraction-contraction. Then, f has a unique fixed point.*

In (1976), M. S. Khan [41] proved the following fixed point theorem.

Theorem 1.3. Let (X, d) be a complete metric space and let $f : X \longrightarrow X$ be a mapping satisfying the following condition:

$$d(f(x), f(y)) \leq \mu \frac{d(x, f(x))d(x, f(y)) + d(y, f(y))d(y, f(x))}{d(x, f(y)) + d(y, f(x))}, \quad \mu \in (0, 1) \tag{1.2}$$

Then f has a unique fixed point $u \in X$. Moreover, for all $x_0 \in X$, the sequence $\{f^n(x_0)\}$ converges to u.

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Remark 1.4. It was shown by B. Fisher [19] that Theorem 1.3 is incorrect and needed the extra condition, which is $d(x, f(y)) + d(y, f(x)) = 0$ implies that $d(f(x), f(y)) = 0$ for the theorem to hold. Thus, the true version of Theorem 1.1 is as follows.

Theorem 1.5. Let (X, d) be a complete metric space and let $f : X \longrightarrow X$ be a mapping satisfying the following condition:

$$d(f(x), f(y)) < \mu \frac{d(x, f(x))d(x, f(y)) + d(y, f(y))d(y, f(x))}{d(x, f(y)) + d(y, f(x))}, \quad \mu \in (0, 1) \tag{1.3}$$

$$\text{if } d(x, f(y)) + d(y, f(x)) \neq 0 \tag{$\star$}$$

and

$$d(f(x), f(y)) = 0 \text{ if } d(x, f(y)) + d(y, f(x)) = 0. \tag{$\star\star$}$$

Then f has a unique fixed point $u \in X$. Moreover, for all $x_0 \in X$, the sequence $\{f^n(x_0)\}$ converges to u.

Some variations of Theorem 1.2 and its extensions are established by several authors (see [5, 6, 17, 19, 23, 28, 42, 45, 46, 48, 49, 51]). Very recently, Karapınar [31] introduce interpolative Kannan-Meir-Keeler type contraction. Definition 1.6 and Theorem 1.7 are given below.

Definition 1.6. *[31] Let (X, d) be a complete metric space. A mapping $f : X \to X$ is said to be an* interpolative Kannan-Meir-Keeler type contraction *on X (on short, KMK-contraction), if there exists $\gamma \in (0, 1)$ such that for every $u, v \in X \setminus \mathrm{Fix}(f)$ we have*

(1) given $\varepsilon > 0$, there exists $\delta > 0$ such that

$$\varepsilon < [d(u, fu)]^{\gamma}[d(v, fv)]^{1-\gamma} < \varepsilon + \delta \implies d(fu, fv) \leq \varepsilon. \tag{2}$$

Also we have

(2)

$$d(fu, fv) < d(u, fu)]^{\gamma}[d(v, fv)]^{1-\gamma}. \tag{3}$$

Theorem 1.7. *[31] On a complete metric space (X, d), any interpolative KMK-contraction $f : X \to X$ has a fixed point.*

2. Main Results

We start this section by giving the definition of interpolative Meir-Keeler contraction of rational Das-Gupta.

Definition 2.1. *Let (X, d) be a metric space and $f : X \to X$ be a mapping. We say that f is an* interpolative Meir-Keeler contraction of rational Das-Gupta *on X if there exists $\gamma \in (0, 1)$, such that for every $u, v \in X \setminus \mathrm{Fix}(f)$ we have*

(1) given $\varepsilon > 0$, there exists $\delta(\varepsilon) > 0$ so that

$$\varepsilon \leq \mathcal{R}(u, v) < \varepsilon + \delta \implies d(fu, fv) < \varepsilon, \tag{4}$$

(2)

where

$$\mathcal{R}(u,v) = (d(u,v))^{\gamma}\left(\frac{d(v,fv)\cdot(1+d(u,fu))}{1+d(u,v)}\right)^{1-\gamma} \tag{5}$$

Lemma 2.2. *Let (X,d) be a metric space and $f : X \to X$ be an* interpolative Meir-Keeler contraction of rational Das-Gupta *on X. Then, we have*

$$d(fu,fv) < \mathcal{R}(u,v), \tag{6}$$

Theorem 2.3. *On a complete metric space (X,d), any interpolative Meir-Keeler contraction of rational Das-Gupta $f : X \to X$ has a fixed point.*

Proof. Let $u_0 \in X$, be an arbitrary point and the sequence $\{u_p\}$, be defined by the following rule:

$$u_p = fu_{p-1} = f^p u_0, \text{ for all } p \in \mathbb{N}. \tag{7}$$

(We can assume that $u_p \neq u_{p+1}$ for every $p \in \mathbb{N}\cup\{0\}$. If not, then there exists $p_0 \in \mathbb{N}\cup\{0\}$ such that $u_{p_0} = u_{p_0+1} = fu_{p_0}$. Therefore, we get that u_{p_0} is a fixed point of the mapping f, which close the proof.)
Thus, by (6), letting $u = u_{p-1}$ and $v = u_p$, we have

$$\begin{aligned} d(u_p,u_{p+1}) &= d(fu_{p-1},fu_p) < \mathcal{R}(u_{p-1},u_p) \\ &= \left(d(u_{p-1},u_p)\right)^{\gamma}\left(\frac{d(u_p,fu_p)\cdot\left(1+d(u_{p-1},fu_{p-1})\right)}{1+d(u_{p-1},u_p)}\right)^{1-\gamma} \\ &= \left(d(u_{p-1},u_p)\right)^{\gamma}\left(d(u_p,u_{p+1})\right)^{1-\gamma} \end{aligned}$$

Therefore, we get that $d(u_p,u_{p+1}) < d(u_{p-1},u_p)$, which shows that sequence $\{d(u_p,u_{p+1})\}$ is strictly decreasing. On the other hand, since $d(u_p,u_{p+1}) > 0$, for every $p \in \mathbb{N}\cup\{0\}$, we have that the sequence $\{d(u_p,u_{p+1})\}$ is convergent, and then, there exists a point $\ell \geq 0$ such that $\lim_{p\to\infty} d(u_p,u_{p+1}) = \ell$. We claim that $\ell = 0$. On the contrary, if $\ell > 0$, taking $\varepsilon = \ell$, from (4), we have that there exists $\delta(\ell) > 0$ such that

$$\ell < \mathcal{R}(u_{p-1},u_p) < \ell + \delta(\ell) \text{ implies } d(fu_{p-1},fu_p) \leq \ell. \tag{8}$$

On the other hand, since $d(u_p,u_{p+1}) \searrow \ell$, for $\delta(\ell) > 0$ we can find $N \in \mathbb{N}$, such that

$$\begin{aligned} \ell &< d(u_p,u_{p+1}) < \mathcal{R}(u_{p-1},u_p) \\ &= \left(d(u_{p-1},u_p)\right)^{\gamma}\left(\frac{d(u_p,fu_p)\cdot\left(1+d(u_{p-1},fu_{p-1})\right)}{1+d(u_{p-1},u_p)}\right)^{1-\gamma} \\ &= \left(d(u_{p-1},u_p)\right)^{\gamma}\left(d(u_p,u_{p+1})\right)^{1-\gamma} \\ &\leq d(u_{p-1},u_p) < \ell + \delta(\ell), \end{aligned}$$

for any $p \geq N$. Therefore, taking (8) into account, it follows that

$$d(u_p,u_{p+1}) < \ell, \text{ for any } p \geq N, \tag{9}$$

a contradiction. Hence, we find $\lim_{p\to\infty} d(u_p,u_{p+1}) = \ell = 0$.

We claim now that $\{u_p\}$ is a Cauchy sequence. Based on (6), we have

$$\begin{aligned} d(u_p,u_q) &< \mathcal{R}(u_{p-1},u_{q-1}) \\ &= \left(d(u_{q-1},u_{p-1})\right)^{\gamma}\left(\frac{d(u_{q-1},fu_{q-1})\cdot\left(1+d(u_{p-1},fu_{p-1})\right)}{1+d(u_{q-1},u_{p-1})}\right)^{1-\gamma} \end{aligned} \tag{10}$$

Letting $p, q \to \infty$, the right hand tends to zero. Hence, we find that $\lim_{p,q\to\infty} d(u_p, u_q) = 0$

Therefore, the sequence $\{u_p\}$ is Cauchy and by the completeness of the space X it follows that there exists $u^* \in X$ such that

$$\lim_{p\to\infty} u_p = u^*, \tag{11}$$

and also, $\lim_{p\to\infty} fu_p = u^*$.
By (6) we have

$$\begin{aligned} 0 \le d(u^*, fu^*) \le \quad & d(u^*, u_{p+1}) + d(u_{p+1}, fu^*) = d(u_*, u_{p+1}) + d(fu_p, fu_*) \\ & < d(u^*, u_{p+1}) + \mathcal{R}(u^*, u_p) \\ & = d(u^*, u_{p+1}) + \left(d(u^*, u_p)\right)^{\gamma} \left(\frac{d(u_p, fu_p) \cdot (1 + d(u^*, fu^*))}{1 + d(u^*, u_p)}\right)^{1-\gamma} \end{aligned}$$

Therefore, $d(u^*, fu^*) = 0$, that is, u^* is a fixed point of the mapping f. □

Example 2.4. *Let $X = [1, +\infty)$ and the distance $d : X \times X \to [0, +\infty)$, with $d(u, v) = \begin{cases} \max\{u, v\}, & \text{if } u \neq v \\ 0, & \text{if } u = v \end{cases}$. Let also the mapping $f : X \to X$, be defined by*

$$fu = \begin{cases} 1, & \text{for } u \in [1, 2] \\ \frac{1}{2}, & \text{for } u \in (2, +\infty). \end{cases}$$

Since $d(fu, fv) = 0$ for any $u, v \in [1, 2]$, respectively $u, v \in (2, +\infty)$, it follows that (6) holds for these cases. If $u \in (2, +\infty)$ and $v \in [1, 2]$, we have

$$\begin{aligned} d(fu, fv) &= \max\left\{1, \tfrac{1}{2}\right\} = 1, \ d(u, v) = \max\{u, v\} = u, \\ d(u, fu) &= \max\left\{u, \tfrac{1}{2}\right\} = u, \ d(v, fv) = \max\{v, 1\} = v, \\ \mathcal{R}(u, v) &= [d(u, v)]^{\gamma} \left[\frac{d(v, fv)(1 + d(u, fu))}{1 + d(u, v)}\right]^{1-\gamma} = u^{\gamma} \left(\frac{v(1+u)}{1+u}\right)^{1-\gamma} = u^{\gamma} v^{1-\gamma}. \end{aligned}$$

Thus, choosing for example $\gamma = \frac{1}{2}$,

$$d(u, v) < \sqrt{uv} = \mathcal{R}(u, v),$$

for any $u \in (2, +\infty)$ and $v \in [1, 2]$. One can see that (6) holds for any $u, v \in X$; that is, f is an interpolative Meir-Keeler contraction of rational Das-Gupta on X. Thus, by Theorem 2.3, the mapping f has a fixed point.

A mapping $\varphi : [0, \infty) \to [0, \infty)$ is called a *comparison function* if it is increasing and $\varphi^n(t) \to 0$, $n \to \infty$, for any $t \in [0, \infty)$. We denote by Φ, the class of the comparison functions $\varphi : [0, \infty) \to [0, \infty)$. For more details and illustrative examples, see e.g. [50]. Among them, we recall the following essential result.

Lemma 2.5. *(Rus [50]) If $\varphi : [0, \infty) \to [0, \infty)$ is a comparison function, then:*

(1) each iterate φ^k of φ, $k \ge 1$, is also a comparison function;

(2) φ is continuous at 0;

(3) $\varphi(t) < t$, for any $t > 0$.

Let Ψ be the family of nondecreasing functions $\psi : [0, \infty) \to [0, \infty)$ so that $\sum_{n=1}^{\infty} \psi^n(t) < \infty$ for each $t > 0$, where ψ^n is the n-th iterate of ψ. It is clear that if $\Phi \subset \Psi$ (see e.g. [26]) and hence, by Lemma 2.5 (3), for $\psi \in \Psi$ we have $\psi(t) < t$, for any $t > 0$.

Remark 2.6. Every function $\psi \in \Psi$ is called a (c)-comparison function. It is easy to prove that if ψ is a (c)-comparison function, then $\psi(t) < t$ for any $t > 0$ and $\psi(0) = 0$.

Definition 2.7. *Let (X, d) be a metric space and $f : X \to X$ be a mapping. We say that f is an* interpolative Meir-Keeler contraction of rational Barada type *on X if there exist $\psi \in \Psi$ and $\gamma \in [0, 1)$, such that for every $u, v \in X$ we have*

(1) given $\varepsilon > 0$, there exists $\delta(\varepsilon) > 0$ so that

$$\varepsilon \leq \psi(\mathcal{B}(u, v)) < \varepsilon + \delta \implies d(fu, fv) < \varepsilon, \tag{12}$$

(2)

where

$$\mathcal{B}(u, v) = (d(u, v))^{\gamma} \left(\frac{d(u, fu)d(u, fv) + d(v, fv)d(v, fu)}{\max\{d(u, fv), d(v, fu)\}} \right)^{1-\gamma}. \tag{13}$$

Lemma 2.8. *Let (X, d) be a metric space and $f : X \to X$ be an* interpolative Meir-Keeler contraction of rational Das-Gupta *on X. Then, we have*

$$d(fu, fv) < \psi(\mathcal{B}(u, v)), \tag{14}$$

Proof. We define the sequence $\{x_k\}$ in X by $x_{k+1} = f(x_k)$ for all $k \geq 0$. If $x_{k_0} = x_{k_0+1}$ for some k_0, then x_{k_0} is a fixed point of f. Now, we assume that $x_k \neq x_{k+1}$ for all $k \in \mathbb{N}$. Now, it follows that

$$\begin{aligned} d(x_{k+1}, x_k) &= d(f(x_k), f(x_{k-1})) \\ &\leq \psi(\mathcal{B}(x_k, x_{k-1})) \\ &\leq \psi\left((d(x_k, x_{k-1}))^{\gamma} \left(\frac{d(x_{k-1}, x_k)d(x_{k-1}, x_{k+1}) + d(x_k, x_{k+1})d(x_k, x_k)}{\max\{d(x_{k-1}, x_{k+1}), d(x_k, x_k)\}} \right)^{1-\gamma} \right) \\ &= \psi\left((d(x_{k-1}, x_k))^{\gamma}\ (d(x_{k-1}, x_k))^{1-\gamma} \right), \\ &= \psi(d(x_{k-1}, x_k)), \end{aligned}$$

for all $k \in \mathbb{N}$. Inductively, we obtain

$$d(x_{k+1}, x_k) \leq \psi^k(d(x_1, x_0)).$$

Now, we prove that $\{x_k\}$ is a Cauchy sequence. Let $\epsilon > 0$ and $n(\epsilon) \in \mathbb{N}$ in such a way that $\sum_{k \geq n(\epsilon)} \psi^k(d(x_1, x_0)) < \epsilon$.
Let $n, m \in \mathbb{N}$ with $m > n > n(\epsilon)$. By the triangle inequality, we get

$$\begin{aligned} d(x_n, x_m) &\leq \sum_{k=n}^{m-1} d(x_k, x_{k+1}) \leq \sum_{k=n}^{m-1} \psi^k(d(x_1, x_0)) \\ &\leq \sum_{k \geq n(\epsilon)} \psi^k(d(x_1, x_0)) < \epsilon. \end{aligned}$$

Hence, we deduce that $\{x_k\}$ is a Cauchy sequence in the complete metric space (X, d). Thus, there exists $u \in X$ such that $\lim_{k \to \infty} x_k = u$.

For each $k \in \mathbb{N}$, we have

$$\begin{aligned} 0 \leq d(u, f(u)) &\leq d(f(x_k), u) + d(f(x_k), f(u)) \\ &\leq d(x_{k+1}, u) + \mathcal{B}(f(x_k), f(u)) \\ &\leq d(x_{k+1}, u) + \psi\left(d(x_k, u)^{\gamma} (\frac{d(x_k, f(x_k))d(x_k, f(u)) + d(u, f(u))d(u, f(x_k))}{d(x_k, f(u)) + d(u, f(x_k))})^{1-\gamma} \right). \end{aligned}$$

Letting $k \longrightarrow \infty$ in the above inequality and using the right continuity of ψ at 0 and Remark 1.1 we infer that

$$d(u, f(u)) \leq 0.$$

Thus, we have $d(u, f(u)) = 0$, that is $u = f(u)$. Therefore $u \in X$ is a fixed point of f which achieves the proof. □

References

[1] T. Abdeljawad, H. Aydi and E. Karapınar, Coupled fixed points for Meir-Keeler contractions in ordered partial metric spaces, Mathematical Problems in Engineering (2012), Article Id. 327273.

[2] R. P. Agarwal and E. Karapınar, Interpolative Rus-Reich-Ciric Type Contractions Via Simulation Functions, An. St. Univ. Ovidius Constanta, Ser. Mat. Volume XXVII (2019) fascicola 3 27(2019), no. 3, 137-152.

[3] U. Aksoy, E. Karapınar, I. M. Erhan, V. Rakocevic, Meir-Keeler Type Contractions on Modular Metric Spaces, Filomat 32 (2018), no. 10, 3697-3707.

[4] M. Asadi, Fixed point theorems for Meir-Keeler type mappings in M-metric spaces with applications, Fixed Point Theory Appl. (2015), 2015:210, 10 pp.

[5] M. Asadi, On Ekeland's variational priciple in M-metric spaces, J. Nonlinear Convex Anal. 17 (2016), no. 6, 1151–1158.

[6] M. Asadi, M. Gabeleh, C. Vetro, A new approach to the generalization of Darbo's fixed point problem by using simulation functions with application to integral equations. Results Math. 74 (2019), no. 2, 15 pp.

[7] H. Aydi, E. Karapınar, A. F. Roldan Lopez de Hierro, ω-Interpolative Ćirić-Reich-Rus-Type Contractions, Mathematics 7 (2019), 57.

[8] H. Aydi, C. M. Chen, E. Karapınar, Interpolative Ciric-Reich-Rus type contractions via the Branciari distance, Mathematics 7 (2019), 84. https://doi.org/10.3390/math7010084.

[9] H. Aydi, E. Karapınar, D. Zhang, A note on generalized admissible-Meir-Keeler-contractions in the context of generalized metric spaces, Results in Mathematics 71 (2017), no. 1, 73-92.

[10] H. Aydi, E. Karapınar, I. Erhan, Coupled coincidence point and coupled fixed point theorems via generalized Meir- Keeler type contractions, Abstr. Appl. Anal. (2012), Article id. 781563.

[11] H. Aydi, C. Vetro, E. Karapınar, Meir-Keeler type contractions for tripled fixed points, Acta Mathematica Scientia 32 (2012), no. 6, 2119-2130.

[12] H. Aydi, E. Karapınar, New Meir-Keeler type tripled fixed point theorems on ordered partial metric spaces, Math. Probl. Eng. 2012 (2012), Article id. 409872.

[13] H. Aydi, E. Karapınar, A Meir-Keeler common type fixed point theorem on partial metric spaces, Fixed Point Theory Appl. (2012), 26.

[14] S. Banach, Sur les opérations dans les ensembles abstraits et leur application aux équations intégrales, Fund. Math. 3 (1922) 133-181.

[15] R. K. Bisht, V. Rakocevic, Generalized Meir-Keeler type contractions and discontinuity at fixed point, Fixed Point Theory, 19(2018), no. 1, 57-64.

[16] C. M. Chen, E. Karapınar, D. O'regan, On $(\alpha - \phi)$-Meir-Keeler contractions on partial Hausdorff metric spaces University Politehnica Of Bucharest Scientific Bulletin-Series A-Applied Mathematics And Physics 80 (2018), no.1, 101-110.

[17] B. K. Dass and S. Gupta, An extension of Banach contraction principle through rational expression, Indian. J. Pure. Appl. Math. 6 (1975), no. 12, 1455-1458.

[18] I. M. Erhan, E. Karapınar, A. D. Turkoglu, Different types Meir-Keeler contractions on partial metric spaces, J. Comput. Anal. Appl. 14 (2012), no. 6, 1000-1005.

[19] B. Fisher, On a theorem of Khan, Riv. Math. Univ Parma. (4) 4 (1978), 135-137.

[20] Y. U. Gaba, E. Karapınar, A New Approach to the Interpolative Contractions. Axioms 8 (2019), 110.

[21] M. Gabeleh, M. Asadi, P.R. Patle, Simulation functions and Meir-Keeler condensing operators with application to integral equations, Asian-European Journal of Mathematics, (2021).

[22] P. Gautam, V. N. Mishra, R. Ali and S. Verma, Interpolative Chatterjea and cyclic Chatterjea contraction on quasi-partial b-metric space, AIMS Mathematics 6(2020), no. 2, 1727-1742. DOI: 10.3934/Math.2021103

[23] A. N. Gupta and A. Saxena, A unique fixed point theorem in metric spaces, The. Math. Student. 52 (1984), no 1-4, 156-158.

[24] S. Gulyaz, E. Karapınar, I. M. Erhan Generalized α-Meir-Keeler Contraction Mappings on Branciari b-metric Spaces Filomat 31 (2017), no. 17, 5445-5456.

[25] N. Hussain, E. Karapınar, P. Salimi and P. Vetro, Fixed point results for G^m-Meir-Keeler contractive and G-(α,ψ)-Meir-Keeler contractive mappings, Fixed Point Theory and Applications 34 (2013).

[26] N. Hussain, Z. Kadelburg, S. Radenović, F. Al-Solamy, Comparison functions and fixed point results in partial metric spaces. Abstr. Appl. Anal. (2012), Art. ID 605781, 15 pp.

[27] C. Y. Li, E. Karapınar, C. M. Chen, A Discussion on Random Meir-Keeler Contractions, Mathematics 8 (2020), 245.

[28] D. S. Jaggi, Some unique fixed point theorems, Indian. J. Pure. Appl. Math. 8 (1977), no. 2 , 223-230.

[29] R. Kannan, Some results on fixed points, Bull. Calcutta Math. Soc. 60 (1968), 71-76.

[30] E. Karapınar, Revisiting the Kannan type contractions via interpolation, Advances in the Theory of Nonlinear Analysis and Its Application 2 (2018), no. 2, 85–87. https://doi.org/10.31197/atnaa.431135

[31] E. Karapınar, Interpolative Kannan- Meir-Keeler type contraction, Adv. Theory Nonlinear Anal. 5 (2021), no. 4, 611 - 614. https://doi.org/10.31197/atnaa.989389
[32] E. Karapınar, H. Aydi, Z. D. Mitrovic, On Interpolative Boyd-Wong And Matkowski Type Contractions, TWMS J. Pure Appl. Math. 11 (2020), no. 2, 204-212.
[33] E. Karapınar, O. Alqahtani, H. Aydi, On Interpolative Hardy-Rogers Type Contractions, Symmetry 11 (2019), no. 8. https://doi.org/10.3390/sym11010008
[34] E. Karapınar, A. Fulga, A. F. Roldan Lopez de Hierro, Fixed point theory in the setting of $(\alpha, \beta, \psi, \phi)$-interpolative contractions, Adv Differ Equ 2021, 339. https://doi.org/10.1186/s13662-021-03491-w
[35] E. Karapınar, R. P. Agarwal, H. Aydi, Interpolative Reich-Rus-Ćirić type contractions on partial-metric spaces, Mathematics 6 (2018), 256. https://doi.org/10.3390/math6110256
[36] E. Karapınar, B. Samet, D. Zhang, Meir-Keeler type contractions on JS-(metric) spaces and related fixed point theorems, J. Fixed Point Theory Appl. 20 (2018), 60.
[37] E. Karapınar, S. Czerwik, H. Aydi, (α, ψ)-Meir-Keeler contraction mappings in generalized b-metric spaces, Journal of Function Spaces (2018), Article Id. 3264620.
[38] E. Karapınar, A. Fulga, Revisiting Meir-Keeler type fixed operators on Branciari distance space, Tbilisi Mathematical Journal 12(2019), no. 4, 97-110.
[39] E. Karapınar, A Note on Meir-Keeler Contractions on dislocated quasi-b-metric, Filomat 31 (2017), no. 13, 4305-4318.
[40] M. S. Khan, Y. M. Singh, E. Karapınar, On the interpolative (varphi, psi)-type z-contraction U.P.B. Sci. Bull., Series A, Vol. 83, Iss. 2, 2021 ISSN 1223-7027.
[41] M. S. Khan, A fixed point theorem for metric spaces, Rend. Inst. Math. Univ. Trieste. 8 (1976), no. 1, 69-72.
[42] M. S. Khan, Some fixed point theorems, Indian. J. Pure. Appl. Math. 8 (1977), no. 12, 1511-1514.
[43] A. Meir, E. Keeler, A theorem on contraction mappings. J. Math. Anal. Appl. 28 (1969), 326-329.
[44] V. N. Mishra, M.S.R. Luis, P. Gautam, S.Verma, Interpolative Reich-Rus-Ciric and Hardy-Rogers Contraction on Quasi-Partial b-Metric Space and Related Fixed Point Results, Mathematics 8(2020), no. 9, 1598. https://doi.org/10.3390/math8091598
[45] H. Monfared, M. Asadi, M. Azhini, D. O'Regan, $F(\Psi, \Phi)$-contractions for α-admissible mappings on M-metric spaces. Fixed Point Theory Appl. (2018), no. 22, 17 pp.
[46] H. Monfared, M.Azhini, M. Asadi, A generalized contraction principle with control function on M-metric spaces, Nonlinear Functional Analysis and Applications, 22(2017), no. 2, 395-402.
[47] Z. Mustafa, H.Aydi, E. Karapınar, Generalized Meir Keeler Type Contractions on G-metric spaces, Applied Mathematics and Computation 219 (2013), no. 21, 10441-10447.
[48] B. K. Ray, S. P. Singh, Fixed point theorems in Banach Spaces, Indian. J. Pure. App. Math. 9 (1978), no. 3, 216-221.
[49] N. Redjel, A. Dehici, On some fixed points of generalized contractions with rational expressions and applications, Adv. Fixed. Point. Theory. 5 (2015), no. 1, 56-70.
[50] I.A. Rus, Generalized contractions and applications, Cluj University Press, Cluj-Napoca (2001).
[51] I. A. Rus, Cyclic representations and fixed points, Annals of the tiberiu popoviciu seminar of functional equations, approximation and convexity. 3 (2005), 171-178.