

# Comparative Analysis of Rate of Convergence of Agarwal et al., Noor and SP iterative schemes for Complex Space

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## ABSTRACT

In this paper, we analyze the rate of convergence of three iterative schemes namely-Agarwal et al., Noor and SP iterative schemes for complex space by using Matlab programmes. The results obtained are extensions of some recent results of Rana, Dimri and Tomar[1].

## General Terms

Computational Mathematics

## Keywords

Agarwal et al. iterative scheme, Noor iterative scheme, SP iterative scheme

## 1. INTRODUCTION

Although fixed point iterative schemes are used in solving problems of industrial and applied mathematics still there is no systematic study of numerical aspects of these iterative schemes. In computational mathematics, it is important to compare the iterative schemes with regard to their rate of convergence. By using computer programs, perhaps for the first time, B. E. Rhoades [2] illustrated the difference in convergence rate of Mann and Ishikawa iterative procedures for increasing and decreasing functions through examples. S. L. Singh[3] extended the work of Rhoades. In [4,5] Berinde showed that Picard iteration converges faster than Mann iteration for quasi-contractive operators.

Recently, Nawab Hussain et al. [6] provide an example of a quasi-contractive operator for which the iterative scheme due to Agarwal et al. is faster than Mann and Ishikawa iterative schemes. By providing examples, W. Phuengrattana and S. Suantai[7] showed that SP iterative scheme converges faster than Mann, Ishikawa and Noor iterative for nondecreasing and continuous functions on real line intervals. Recently, Rana, Dimri and Tomar[1] showed that Ishikawa iterative scheme converges faster than Mann iterative scheme while Picard iterative scheme converges faster than both in complex space.

## 2. PRELIMINARIES

Let  $(X, d)$  be a complete metric space and  $T: X \rightarrow X$  a selfmap of  $X$ . Suppose that  $F(T) = \{p \in X, Tp = p\}$  is the set of fixed points of  $T$ . There are several iterative processes in the literature for which the fixed points of operators have

been approximated over the years by various authors. In a complete metric space, the Picard iterative process  $\{x_n\}_{n=0}^{\infty}$  defined by

$$x_{n+1} = Tx_n \quad n = 0, 1, \dots \quad (2.1)$$

is used to approximate the fixed points of mappings satisfying the following Banach's contraction condition:

$$d(Tx, Ty) \leq \alpha d(x, y) \quad (2.2)$$

for all  $x, y \in X$  and  $\alpha \in [0, 1]$ .

In 1953, W. R. Mann defined the Mann iteration [8] as

$$x_{n+1} = (1 - \alpha_n)x_n + \alpha_n Tx_n \quad (2.3)$$

where  $\{\alpha_n\}$  is a sequences of positive numbers in  $[0, 1]$ .

In 1974, S. Ishikawa defined the Ishikawa iteration [9] as

$$x_{n+1} = (1 - \alpha_n)x_n + \alpha_n Ty_n$$

$$y_n = (1 - \beta_n)x_n + \beta_n Tx_n, \quad (2.4)$$

where  $\{\alpha_n\}$  and  $\{\beta_n\}$  are sequences of positive numbers in  $[0, 1]$ .

In 2007, Agarwal et al. defined the Agarwal et al. iterative scheme [10] as

$$s_{n+1} = (1 - \alpha_n)Ts_n + \alpha_n Tt_n$$

$$t_n = (1 - \beta_n)s_n + \beta_n Ts_n, \quad (2.5)$$

where  $\{\alpha_n\}$  and  $\{\beta_n\}$  are sequences of positive numbers in  $[0, 1]$ .

In 2000, M. A. Noor defined the three step Noor iteration [11] as

$$x_{n+1} = (1 - \alpha_n)x_n + \alpha_n Ty_n$$

$$y_n = (1 - \beta_n)x_n + \beta_n Tz_n$$

$$z_n = (1 - \gamma_n)x_n + \gamma_n Tx_n, \quad (2.6)$$

where  $\{\alpha_n\}$ ,  $\{\beta_n\}$  and  $\{\gamma_n\}$  are sequences of positive numbers in  $[0, 1]$ .

Phuengrattana and Suantai defined the SP iteration [7] as

$$x_{n+1} = (1 - \alpha_n)y_n + \alpha_n Ty_n$$

$$y_n = (1 - \beta_n)z_n + \beta_n Tz_n$$

$$z_n = (1 - \gamma_n)x_n + \gamma_n Tx_n, \quad (2.7)$$

where  $\{\alpha_n\}$ ,  $\{\beta_n\}$  and  $\{\gamma_n\}$  are sequences of positive numbers in  $[0, 1]$ .

## Remarks

1. If  $\gamma_n = 0$ , then Noor iteration (2.6) reduces to the Ishikawa iteration (2.4).

2. If  $\beta_n = \gamma_n = 0$ , then Noor iteration (2.6) reduces to the Mann iteration (2.3).

3. If  $\beta_n = \gamma_n = 0$ , then SP iteration (2.7) reduces to the Mann iteration (2.3).

In this paper, we take  $\alpha_n = s$ ,  $\beta_n = s'$ ,  $\gamma_n = s''$  and derive the fixed points of the following polynomial functions :

Quadratic functions =  $z^2 + c$

Cubic functions =  $z^3 + c$

Biquadratic functions =  $z^4 + c$

Recently, Rana, Dimri and Tomar[1] draw a comparative analysis of Picard, Mann and Ishikawa iterative schemes by starting with  $z = (0,0)$  and  $c = 0.1$  in complex space.

In this paper, we will continue the comparative study in complex space by taking same  $z$  and  $c$ , for Agarwal et al., Noor and SP iterative schemes and hence extend the results of Rana, Dimri and Tomar[1].

### 3. EXPERIMENTS

#### 3.1 Fixed points of quadratic polynomial

Table 1 (Agarwal et al. iteration )  $s=0.6$  ,  $s'=0.1$

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.10006	6	0.112696
2	0.110132	7	0.112701
3	0.112155	8	0.112701
4	0.112585	9	<b>0.112702</b>
5	0.112677	10	<b>0.112702</b>

Figure 1 (Agarwal et al. iteration )

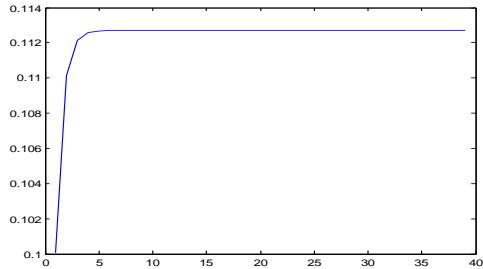


Table 2 (Noor iteration)  $s = 0.6$ ,  $s' = s'' = 0.1$

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.06006	12	0.112663
2	0.086518	13	0.112681
3	0.099323	14	0.112691
4	0.105777	15	0.112696
5	0.109094	16	0.112699
6	0.110816	17	0.1127
7	0.111715	18	0.112701
8	0.112184	19	0.112701
9	0.11243	20	0.112701
10	0.112559	21	<b>0.112702</b>
11	0.112627	22	<b>0.112702</b>

Figure 2 ( Noor iteration)

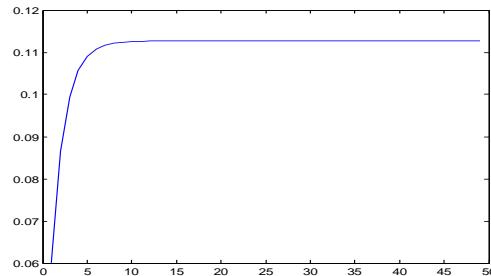


Table 3 (SP iteration )  $s=0.6$ ,  $s' = s'' = 0.1$

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.067821	10	0.112667
2	0.093306	11	0.112686
3	0.104064	12	0.112695
4	0.108806	13	0.112698
5	0.110935	14	0.1127
6	0.111899	15	0.112701
7	0.112336	16	0.112701
8	0.112535	17	<b>0.112702</b>
9	0.112626	18	<b>0.112702</b>

Figure 3 (SP iteration)

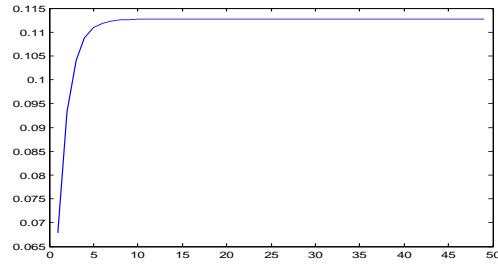
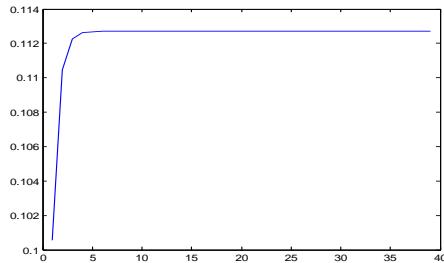


Table 4 (Agarwal et al. iteration )  $s = 0.6$  ,  $s' = 0.3$

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.10054	6	0.112699
2	0.11046	7	0.112701
3	0.112271	8	<b>0.112702</b>
4	0.112618	9	<b>0.112702</b>
5	0.112685	10	<b>0.112702</b>

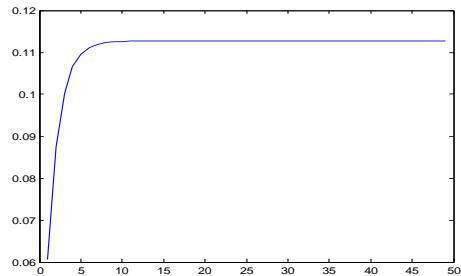
**Figure 4 (Agarwal et al. iteration )**



**Table 5 (Noor iteration )  $s = 0.6$ ,  $s' = 0.3, s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.060541	12	0.112676
2	0.08747	13	0.112689
3	0.100248	14	0.112695
4	0.106495	15	0.112698
5	0.109594	16	0.1127
6	0.111142	17	0.112701
7	0.111918	18	0.112701
8	0.112308	19	0.112701
9	0.112503	20	<b>0.112702</b>
10	0.112602	21	<b>0.112702</b>
11	0.112652	22	<b>0.112702</b>

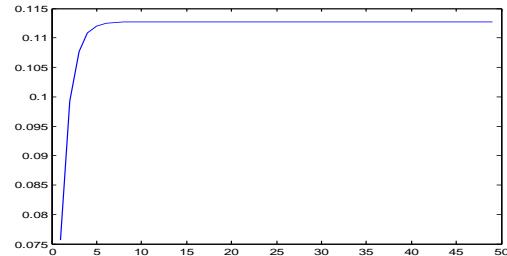
**Figure 5 (Noor iteration)**



**Table 6 (SP iteration)  $s=0.6$ ,  $s' = 0.3, s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.075635	9	0.112687
2	0.099294	10	0.112696
3	0.107705	11	0.1127
4	0.11082	12	0.112701
5	0.11199	13	0.112701
6	0.112432	14	<b>0.112702</b>
7	0.1126	15	<b>0.112702</b>
8	0.112663	16	<b>0.112702</b>

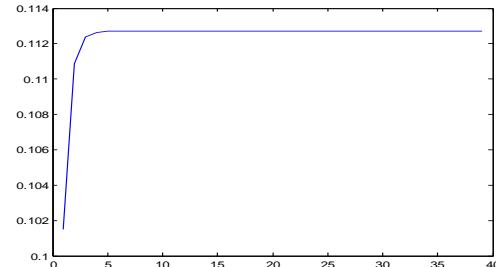
**Figure 6 ( SP iteration)**



**Table 7 (Agarwal et al. iteration )  $s = 0.6$  ,  $s' = 0.5$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.1015	6	0.1127
2	0.11085	7	0.112701
3	0.112384	8	<b>0.112702</b>
4	0.112647	9	<b>0.112702</b>
5	0.112692	10	<b>0.112702</b>

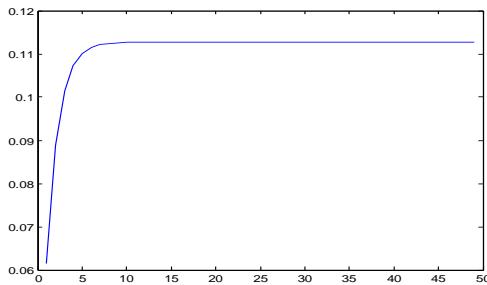
**Figure 7 (Agarwal et al. iteration )**



**Table 8 (Noor iteration )  $s=0.6$ ,  $s' = 0.5, s'' = 0.4$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.061548	12	0.112687
2	0.088838	13	0.112695
3	0.101424	14	0.112698
4	0.107339	15	0.1127
5	0.110145	16	0.112701
6	0.111481	17	0.112701
7	0.112118	18	0.112701
8	0.112423	19	<b>0.112702</b>
9	0.112568	20	<b>0.112702</b>
10	0.112638	21	<b>0.112702</b>
11	0.112671	22	<b>0.112702</b>

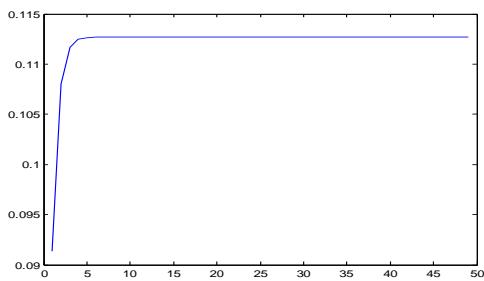
**Figure 8 (Noor iteration )**



**Table 9 (SP iteration)  $s=0.6$ ,  $s' = 0.5, s'' = 0.4$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.091328	6	0.11269
2	0.108027	7	0.112699
3	0.111652	8	0.112701
4	0.112464	9	<b>0.112702</b>
5	0.112648	10	<b>0.112702</b>

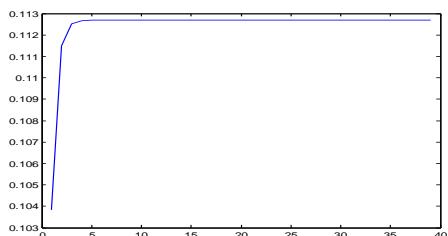
**Figure 9 (SP iteration )**



**Table 10 (Agarwal et al. iteration )  $s = 0.6$ ,  $s' = 0.8$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.10384	5	0.112698
2	0.111493	6	0.112701
3	0.112531	7	<b>0.112702</b>
4	0.112678	8	<b>0.112702</b>

**Figure 10 (Agarwal et al. iteration )**

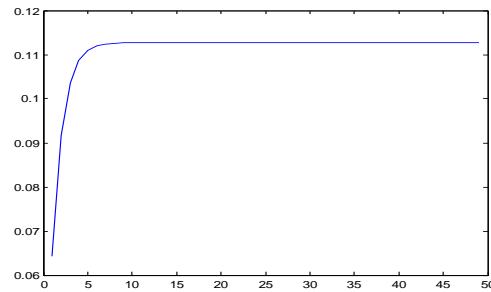


**Table 11 (Noor iteration)  $s=0.6$ ,  $s' = 0.8, s'' = .7$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.064226	12	0.112696
2	0.091647	13	0.112699
3	0.103513	14	0.112701

4	0.108682	15	0.112701
5	0.110942	16	0.112701
6	0.111931	17	<b>0.112702</b>
7	0.112364	18	<b>0.112702</b>
8	0.112554	19	<b>0.112702</b>
9	0.112637	20	<b>0.112702</b>
10	0.112673	21	<b>0.112702</b>
11	0.112689	22	<b>0.112702</b>

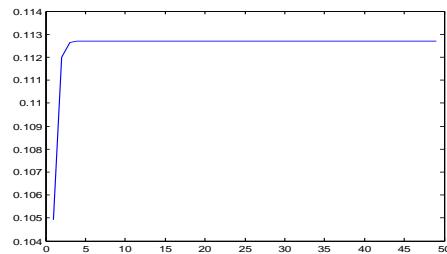
**Figure 11 (Noor iteration )**



**Table 12 (SP iteration)  $s = 0.6$ ,  $s' = 0.8, s'' = 0.7$**

Number of iterations	$x_n$
1	0.104921
2	0.111992
3	0.112636
4	0.112696
5	0.112701
6	<b>0.112702</b>
7	<b>0.112702</b>

**Figure 12 (SP iteration)**

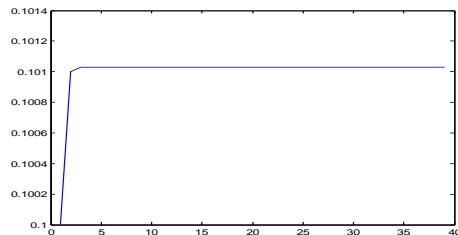


### 3.2 Fixed points of cubic polynomial

**Table 13 (Agarwal et al. iteration )  $s = 0.6$ ,  $s' = 0.1$**

Number of iterations	$x_n$
1	0.100001
2	0.101002
3	0.10103
4	<b>0.101031</b>
5	<b>0.101031</b>
6	<b>0.101031</b>

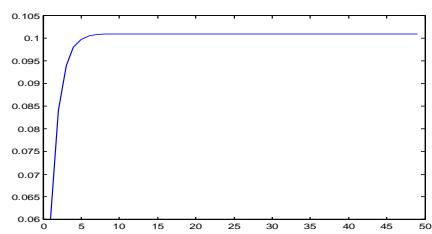
**Figure 13 (Agarwal et al. iteration )**



**Table 14 (Noor iteration)  $s = 0.6$ ,  $s' = s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.060001	9	0.100995
2	0.084158	10	0.101016
3	0.094042	11	0.101025
4	0.098127	12	0.101029
5	0.099823	13	0.10103
6	0.100528	14	<b>0.101031</b>
7	0.100822	15	<b>0.101031</b>
8	0.100944	16	<b>0.101031</b>

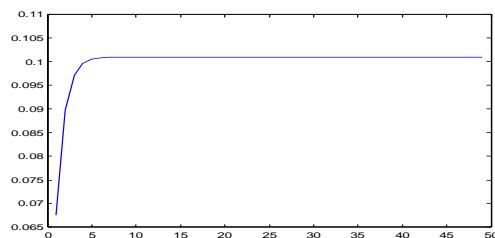
**Figure 14 (Noor iteration)**



**Table 15 (SP iteration)  $s = 0.6$ ,  $s' = s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	<b>0.067604</b>	8	<b>0.101014</b>
2	<b>0.089771</b>	9	<b>0.101025</b>
3	<b>0.097207</b>	10	<b>0.101029</b>
4	<b>0.099728</b>	11	<b>0.101031</b>
5	<b>0.100587</b>	12	<b>0.101031</b>
6	<b>0.10088</b>	13	<b>0.101031</b>
7	<b>0.10098</b>	14	<b>0.101031</b>

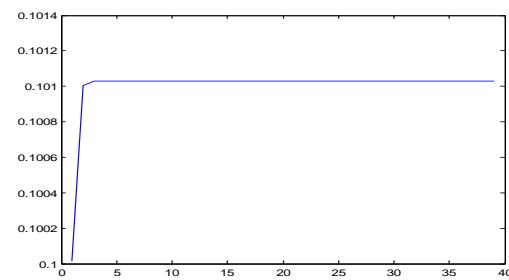
**Figure 15 (SP iteration)**



**Table 16 (Agarwal et al. iteration )  $s=0.6$  ,  $s'=0.3$**

Number of iterations	$x_n$
1	0.100016
2	0.101006
3	<b>0.101031</b>
4	<b>0.101031</b>
5	<b>0.101031</b>

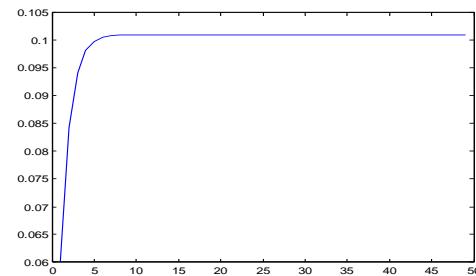
**Figure 16 (Agarwal et al. iteration )**



**Table 17 (Noor iteration)  $s = 0.6$ ,  $s' = 0.3, s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.060016	9	0.100997
2	0.084231	10	0.101017
3	0.094118	11	0.101025
4	0.09818	12	0.101029
5	0.099854	13	0.10103
6	0.100545	14	<b>0.101031</b>
7	0.100831	15	<b>0.101031</b>
8	0.100948	16	<b>0.101031</b>

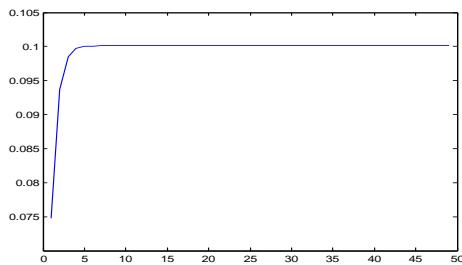
**Figure 17 (Noor iteration)**



**Table 18 ( SP iteration)  $s = 0.6$ ,  $s' = 0.3, s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.074831	7	0.101022
2	0.094084	8	0.101029
3	0.099175	9	<b>0.101031</b>
4	0.100534	10	<b>0.101031</b>
5	0.100898	11	<b>0.101031</b>
6	0.100996	12	<b>0.101031</b>

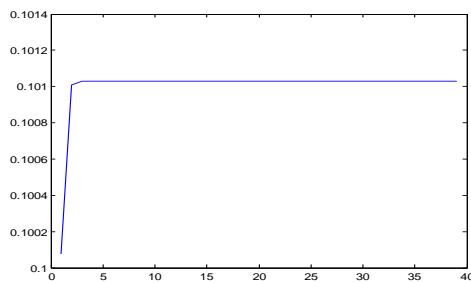
**Figure 18 (SP iteration)**



**Table 19 (Agarwal et al. iteration )  $s = 0.6, s' = 0.5$**

Number of iterations	$x_n$
1	0.100075
2	0.101011
3	<b>0.101031</b>
4	<b>0.101031</b>
5	<b>0.101031</b>
6	<b>0.101031</b>

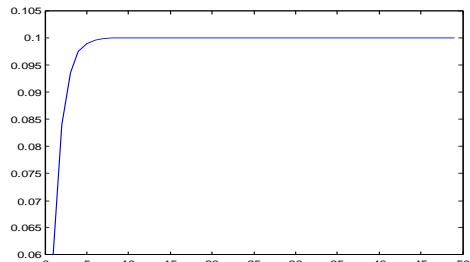
**Figure 19 (Agarwal et al. iteration )**



**Table 20 (Noor iteration)  $s = 0.6, s' = 0.5, s'' = 0.4$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.060075	9	0.100999
2	0.08434	10	0.101018
3	0.094212	11	0.101026
4	0.098242	12	0.101029
5	0.09989	13	0.10103
6	0.100564	14	<b>0.101031</b>
7	0.10084	15	<b>0.101031</b>
8	0.100953	16	<b>0.101031</b>

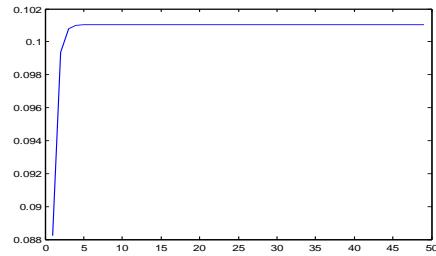
**Figure 20 (Noor iteration)**



**Table 21 ( SP iteration)  $s = 0.6, s' = 0.5, s'' = 0.4$**

Number of iterations	$x_n$
1	0.088219
2	0.099351
3	0.10081
4	0.101002
5	0.101027
6	<b>0.101031</b>
7	<b>0.101031</b>
8	<b>0.101031</b>

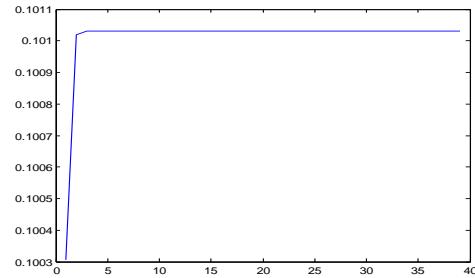
**Figure 21 (SP iteration)**



**Table 22 (Agarwal et al. iteration )  $s=0.6, s' = 0.8$**

Number of iterations	$x_n$
1	0.100307
2	0.101019
3	<b>0.101031</b>
4	<b>0.101031</b>
5	<b>0.101031</b>
6	<b>0.101031</b>

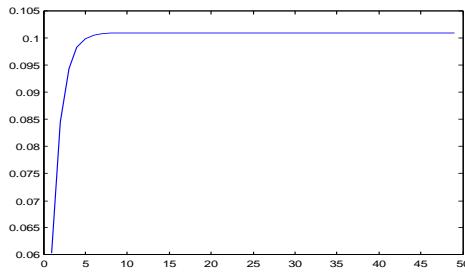
**Figure 22 (Agarwal et al. iteration )**



**Table 23 (Noor iteration )  $s=0.6, s' = 0.8, s'' = 0.7$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.06031	9	0.100997
2	0.084601	10	0.101017
3	0.094399	11	0.101025
4	0.098353	12	0.101029
5	0.09995	13	0.10103
6	0.100595	14	<b>0.101031</b>
7	0.100855	15	<b>0.101031</b>
8	0.10096	16	<b>0.101031</b>

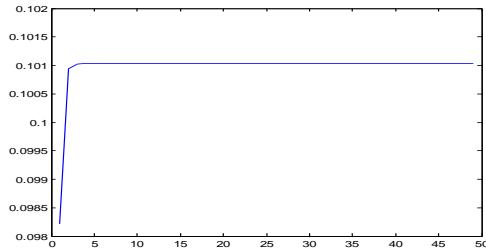
**Figure 23 (Noor iteration )**



**Table 24 (SP iteration )  $s=0.6$ ,  $s' = 0.8, s'' = 0.7$**

Number of iterations	$x_n$
1	0.098212
2	0.100946
3	0.101029
4	<b>0.101031</b>
5	<b>0.101031</b>
6	<b>0.101031</b>

**Figure 24 (SP iteration)**

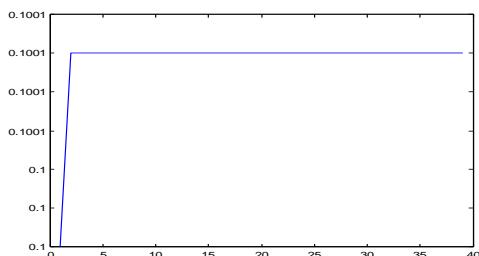


### 3.3 Fixed points of biquadratic polynomial

**Table 25 (Agarwal et al. iteration )  $s = 0.6$  ,  $s' = 0.1$**

Number of iterations	$x_n$
1	0.1
2	<b>0.1001</b>
3	<b>0.1001</b>
4	<b>0.1001</b>
5	<b>0.1001</b>

**Figure 25 (Agarwal et al. iteration )  $s=0.6$  ,  $s' = 0.1$**

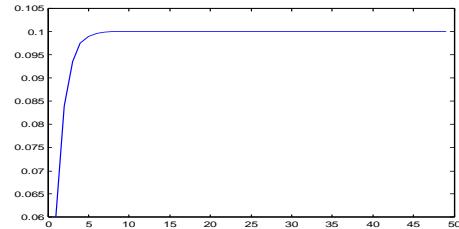


**Table 26 (Noor iteration )  $s=0.6$ ,  $s' = s''=0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.06	8	0.100032
2	0.08401	9	0.100073

3	0.093636	10	0.100089
4	0.097502	11	0.100096
5	0.099056	12	0.100099
6	0.09968	13	<b>0.1001</b>
7	0.099931	14	<b>0.1001</b>

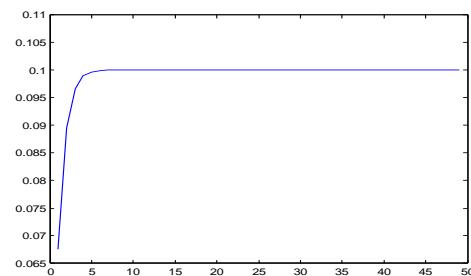
**Figure 26 (Noor iteration )  $s=0.6$ ,  $s' = s''=0.1$**



**Table 27 (SP iteration )  $s = 0.6$ ,  $s' = s''=0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.0676	7	0.100061
2	0.089522	8	0.100088
3	0.096652	9	0.100096
4	0.098976	10	0.100099
5	0.099734	11	<b>0.1001</b>
6	0.099981	12	<b>0.1001</b>

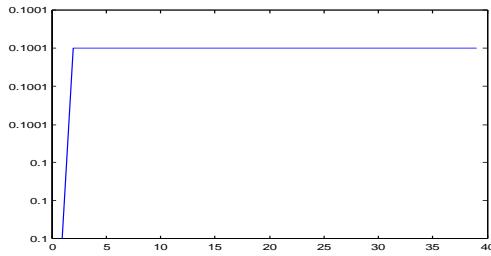
**Figure 27 (SP iteration )  $s = 0.6$ ,  $s' = s''=0.1$**



**Table 28 (Agarwal et al. iteration )  $s=0.6$  ,  $s' = 0.3$**

Number of iterations	$x_n$
1	0.1
2	<b>0.1001</b>
3	<b>0.1001</b>
4	<b>0.1001</b>
5	<b>0.1001</b>

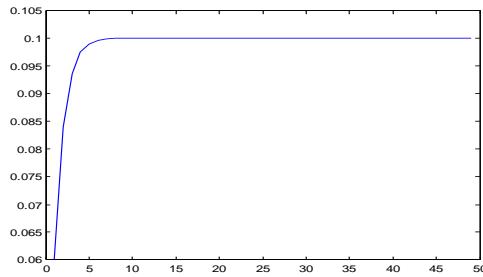
**Figure 28 (Agarwal et al. iteration )  $s = 0.6$  ,  $s' = 0.3$**



**Table 29 (Noor iteration)  $s=0.6, s' = 0.3, s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.06	8	0.100033
2	0.084016	9	0.100073
3	0.093644	10	0.10009
4	0.097508	11	0.100096
5	0.099059	12	0.100099
6	0.099682	13	<b>0.1001</b>
7	0.099932	14	<b>0.1001</b>

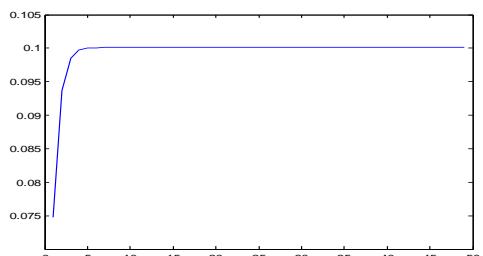
**Figure 29 (Noor Iteration)**



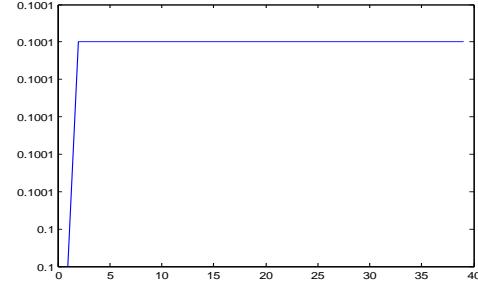
**Table 30 (SP iteration)  $s = 0.6, s' = 0.3, s'' = 0.1$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.074801	6	0.100074
2	0.093685	7	0.100094
3	0.098471	8	0.100099
4	0.099687	9	<b>0.1001</b>
5	0.099995	10	<b>0.1001</b>

**Figure 30 (SP Iteration)**



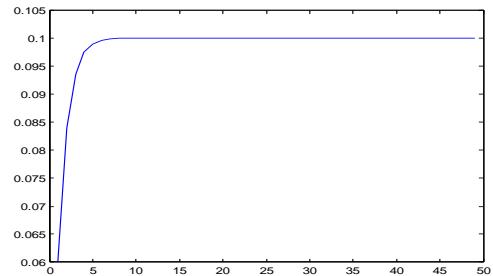
**Figure 31 (Agarwal et al. iteration)**



**Table 32 (Noor iteration)  $s=0.6, s' = 0.5, s'' = 0.4$**

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.060004	8	0.100033
2	0.084026	9	0.100074
3	0.093654	10	0.10009
4	0.097514	11	0.100096
5	0.099063	12	0.100099
6	0.099684	13	<b>0.1001</b>
7	0.099933	14	<b>0.1001</b>

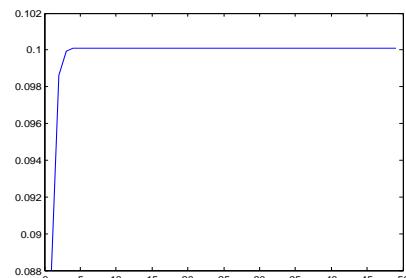
**Figure 32 (Noor Iteration)**



**Table 33 (SP iteration)  $s=0.6, s' = 0.5, s'' = 0.4$**

Number of iterations	$x_n$
1	0.088015
2	0.098633
3	0.099922
4	0.100079
5	0.100098
6	<b>0.1001</b>
7	<b>0.1001</b>
8	<b>0.1001</b>

**Figure 33 (SP Iteration)**



**Table 34 (Agarwal et al. iteration)  $s = 0.6, s' = 0.8$**

Number of iterations	$x_n$
1	0.100004
2	0.1001
3	0.1001
4	0.1001
5	0.1001

Number of iterations	$x_n$
1	0.100025
2	<b>0.1001</b>
3	<b>0.1001</b>
4	<b>0.1001</b>
5	<b>0.1001</b>

Figure 34 (Agarwal et al. iteration)

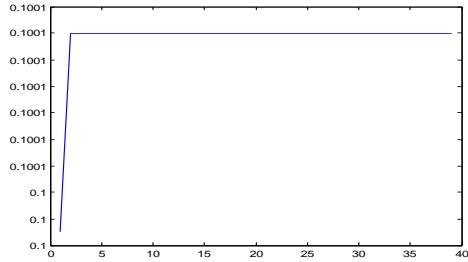


Table 35 (Noor Iteration)  $s = 0.6$ ,  $s' = 0.8$ ,  $s'' = 0.7$

Number of iterations	$x_n$	Number of iterations	$x_n$
1	0.060025	8	0.100034
2	0.084053	9	0.100074
3	0.093674	10	0.10009
4	0.097527	11	0.100096
5	0.09907	12	0.100099
6	0.099688	13	<b>0.1001</b>
7	0.099935	14	<b>0.1001</b>

Figure 35 (Noor Iteration)

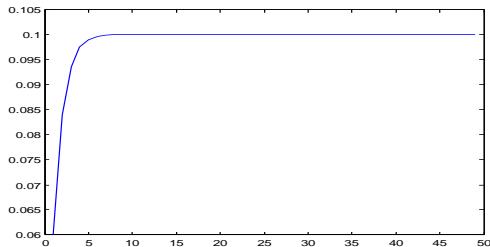
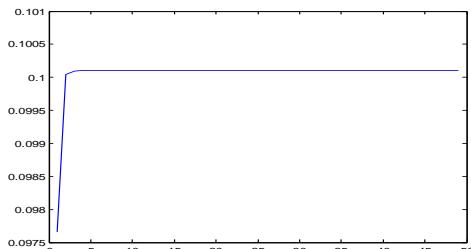


Table 36 (SP Iteration)  $s=0.6$ ,  $s'=0.8$ ,  $s''=0.7$

Number of iterations	$x_n$
1	0.097655
2	0.10004
3	0.100099
4	<b>0.1001</b>
5	<b>0.1001</b>

Figure 36 (SP iteration)



#### 4. OBSERVATIONS

From comparative analysis (in the form of tables and graphs) we observe that in case of **quadratic polynomial** for

(i)  $s=0.6$ ,  $s'=0.1$ ,  $s''=0.1$

(ii)  $s=0.6$ ,  $s'=0.3$ ,  $s''=0.1$

(iii)  $s=0.6$ ,  $s'=0.5$ ,  $s''=0.4$

the decreasing order of convergence rate of iterative schemes is as follows:

Agarwal et al., SP and Noor iterative scheme.

But for  $s = 0.6$ ,  $s' = 0.8$ ,  $s'' = 0.7$  the decreasing order of convergence of iterative schemes is as follows:

SP, Agarwal et al. and Noor iterative scheme.

Also in case of **cubic** and **biquadratic polynomial** the decreasing order of convergence of iterative schemes is Agarwal et al., SP and Noor iterative scheme for all above mentioned cases.

#### 5. CONCLUSION

Keeping in mind comparative analysis drawn by Rana, Dimri and Tomar[1], Tables 1-36 and observations in section 4 we conclude that

(i) In case of quadratic polynomial for  $0 < s < 1$ ,  $0 < s' < s'' \leq \frac{1}{2}$ , the decreasing order of convergence of

iterative schemes is as follows :

Picard, Agarwal et al., SP, Noor, Ishikawa and Mann iterative scheme.

For  $0 < s < 1$ ,  $0 < s' < s'' > \frac{1}{2}$ , Picard and Agarwal et al. iterative schemes shows equivalence while the decreasing order of convergence of iterative schemes is as follows : SP, Agarwal et al., Mann, Noor and Ishikawa iterative scheme.

(ii) In case of cubic polynomial for  $0 < s < 1$ ,  $0 < s' < s'' < \frac{1}{2}$ ,

the decreasing order of convergence rate of iterative schemes is as follows :

Picard, Agarwal et al., SP, Noor, Ishikawa and Mann iterative scheme.

For  $0 < s < 1$ ,  $0 < s' = s'' = \frac{1}{2}$  Picard and Agarwal et al. schemes shows equivalence while decreasing order of convergence of iterative schemes is as follows : Agarwal et al., SP, Ishikawa, Noor and Mann iterative scheme.

For  $0 < s < 1$ ,  $0 < s' < s'' > \frac{1}{2}$ , the decreasing order of convergence rate of iterative schemes is as follows :

Agarwal et al., SP, Mann, Ishikawa and Noor iterative scheme while Picard and Agarwal et al. schemes shows equivalence.

(iii) In case of biquadratic polynomial for  $0 < s < 1$ ,  $0 < s' < s'' < \frac{1}{2}$ , Picard and Agarwal et al. schemes shows equivalence and the decreasing order of convergence rate of iterative schemes is as follows :

Agarwal et al., SP, Noor, Ishikawa and Mann iterative scheme

For  $0 < s < 1$ ,  $s' = s'' = \frac{1}{2}$ , Picard and Agarwal et al. iterative schemes shows equivalence and decreasing order of convergence rate of iterative schemes is as follows :

Agarwal et al., SP, Ishikawa, Noor and Mann iterative scheme.

For  $0 < s < 1, 0 < s', s'' > \frac{1}{2}$ , the decreasing order of

convergence rate of iterative schemes is as follows :

Agarwal et al., SP, Mann, Ishikawa and Noor iterative scheme while Picard and Agarwal et al. schemes shows equivalence. Hence, in case of polynomial functions in complex space,

Picard scheme is best for  $0 < s < 1, 0 < s', s'' \leq \frac{1}{2}$  while for  $0 < s$

$< 1, 0 < s', s'' > \frac{1}{2}$ , Agarwal et al. iterative scheme can have

better convergence rate than the other iterative schemes.

Futhermore, we conclude that with the increase in power of polynomial, convergence rate of all iterative schemes increase rapidly.

### ACKNOWLEDGEMENTS

The authors would like to thank the referee for his/her valuable comments and suggestions.

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