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# Computer Project - 5

## A) PART I

1) I added a convergence criteria to schwarz-overlap.edp. I increased the maximum number of iterations to 500, and changed the convergence tolerance to  $1e-2$ . The file Part-1-schwarz-overlap.edp contains the code. Here are the number of iterations vs  $n$ :

$n$	# of iterations
4	3
8	3
16	3
32	3

2) In schwarz-gc.edp, I changed the LinearCG tolerance to  $1e-6$  and max number of iterations to 500. Here are the results

$n$	# of iterations
4	42
8	60
16	81
32	(this takes a very long time)

when I changed the tolerance to  $1e-2$ , I observed that the same solution as in schwarz-overlap.edp is obtained. Here are the number of iterations vs  $n$ :

$n$	# of iterations
4	3
8	3
16	3
32	3

which are the same as in schwarz-overlap.edp

### B) PART II

In the overlapping case, I changed the convergence tolerance to  $1e-2$  and the maximum number of iterations to 500.

In the non-overlapping case, I changed the LinearCG tolerance to  $1e-6$  and max number of iterations to 500.

Here are the results:

#### 1) The Overlapping Case

##### i) Problem 1

\* The file `Part-2-schwarz-overlap-mfe-Q1.edp` contains the code.

\* These are the results for the number of iterations vs  $h$

$h$	# of iterations
$1/10$	500
$1/20$	500
$1/40$	500
$1/80$	5

\* The results show that the accuracy is acquired for  $h = 1/80$  in 5 iterations

##### ii) Problem 2

\* The file `Part-2-schwarz-overlap-mfe-Q2.edp` contains the code

\* Here are the results:

$h$	# of iterations
$1/10$	500
$1/20$	500
$1/40$	500
$1/80$	4

\* In this case, the desired accuracy is acquired for  $h = 1/80$  in 4 iterations.

### iii) Problem 3

\* The file Part-2-Schwarz-overlap-mfe-Q3.edp contains the code

\* These are the results:

$h$	# of iterations
$1/2$	1
$1/20$	1
$1/40$	1
$1/80$	1

\* In all cases, the desired accuracy is acquired in the first iteration.

### iv) Problem 4

\* The file Part2-Schwarz-overlap-mfe-Q4.edp contains the code

\* These are the results:

$h$	# of iterations
$1/2$	500
$1/20$	500
$1/40$	500
$1/80$	500

\* The desired accuracy is not obtained in any of the cases

## 2) The Non-Overlapping Case

### i) Problem 1

\* The file Part-2-Schwarz-gc-mfe-Q1.edp contains the code

\* These are the results:

$h$	# of iterations
$1/2$	5
$1/20$	10
$1/40$	17
$1/80$	26

\* Compared to the overlapping algorithm, desired accuracy is acquired in all cases with small number of iterations.

## ii) Problem 2

\* The file Port-2-Schwarz-gc-mfc-Q2.edp contains the code.

\* Here are the results:

$h$	# of iterations
$1/10$	5
$1/20$	11
$1/40$	18
$1/80$	28

\* Compared to the overlapping algorithm, desired accuracy is obtained in all cases with small number of iterations (we recall that in the first three values of  $h$ ,  $1e-2$  convergence tolerance is not acquired in the overlapping algorithm.)

## iii) Problem 3

\* The file Port-2-Schwarz-gc-mfc-Q3.edp contains the code

\* Here are the results

$h$	# of iterations
$1/10$	1
$1/20$	
$1/40$	
$1/80$	12

\* For  $h=1/20$  and  $h=1/40$ , I receive the message "GC gR2=0<1e-30 Nothing to do"

\* When I compare the solutions from overlapping and non-overlapping codes, they seem to differ along  $x=0.5$ . This is related to shape of  $\Omega$  and choice of overlapping regions in the two algorithms.

## iv) Problem 4

\* The file Port-2-Schwarz-gc-mfc-Q4.edp contains the code. Here are the results:

$h$	# of iterations
$1/10$	5
$1/20$	10
$1/40$	18
$1/80$	27

\* We observe that the desired accuracy is obtained in all the cases. We can recall that the convergence tolerance  $1e-2$  is not acquired in any of the cases in the overlapping algorithm. Here, we can note that since  $K$  is discontinuous along  $x=0.5$ , it is important to take the interface to be along  $x=0.5$  to get convergent results.