

HW9

20211119 박 건 호

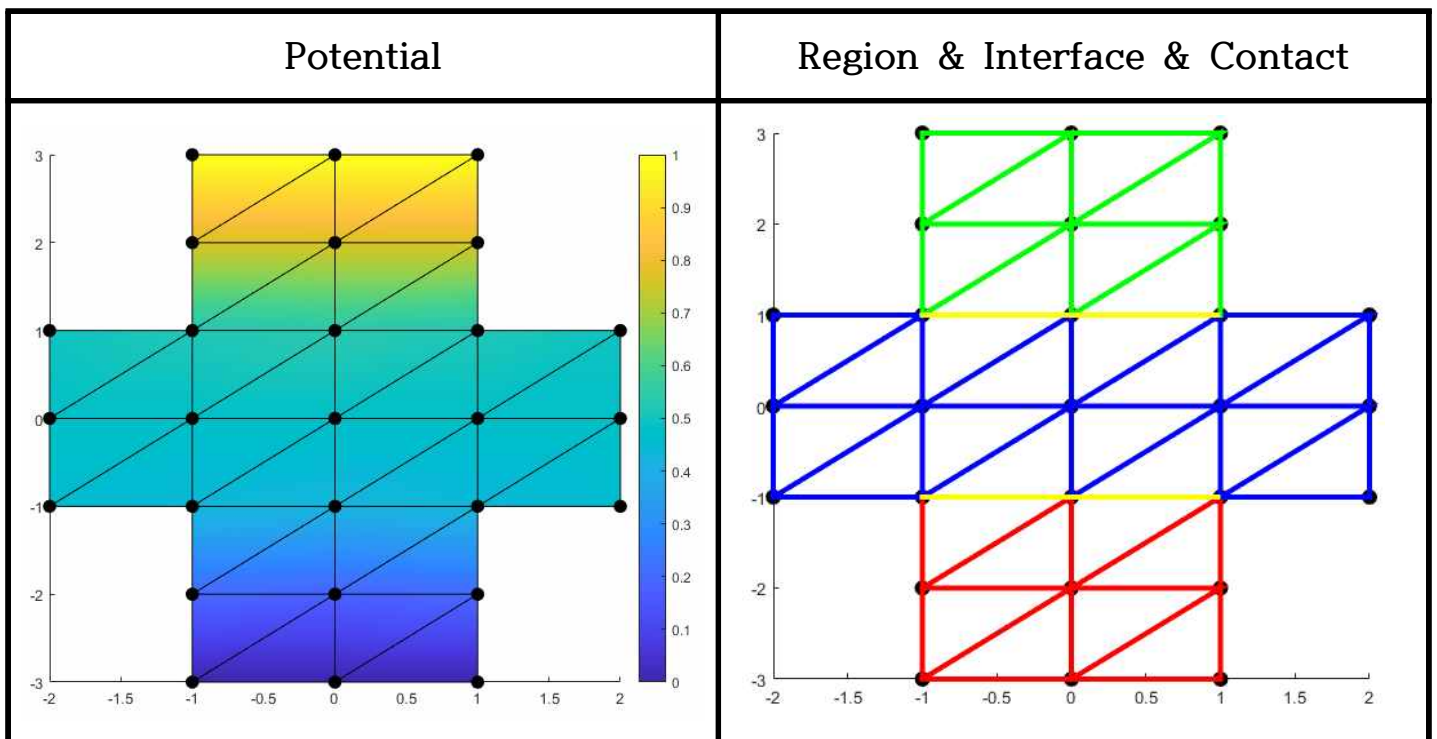
수업에서 진행한 것과 동일하게 Interface의 노드에 대해서 각 region 별로 Flux를 나눠서 생각하여 Jacobian matrix를 제작하였습니다. 또한, Si 과 같은 represent한 region과 그렇지 않은 region이 나뉘는데, 실제 Jacobian 성분을 가지는 부분은 Si로 설정하고 Oxide에는 두 Flux가 동일하다는 Boundary condition을 입력하여 전체 결과를 확인했을 때 두 flux의 결과가 같은지 확인하였습니다.

우선, 기존의 방식은 Jacobian의 전체 크기를 vertex의 전체 수로 설정하여 해당 element에 대해서 계산 결과를 해당하는 index 번호에 바로 더하는 형태의 코드를 제작했습니다.

하지만, 이번 과제에서는 region 별로 Jacobian을 따로 형성한 뒤, Interface를 고려해줘서 해당 수만큼 index에 더해줘 전체 Jacobian의 크기를 확장한 뒤, 확장된 Jacobian에 해당하는 값을 넣어줘 Re-index하는 과정을 진행했습니다. 새롭게 제작한 Jacobian 내부에는 Interface에 두 방향의 flux를 고려한 항이 각각 존재하는데, 그 중 Oxide region에 해당하는 경우, Silicon region에 해당하는 항과 값을 더해준 뒤, Oxide region 항에는 Boundary Condition을 지정하였습니다.

또 다른 방식으로, 기존의 방식이 값을 더해서 하는 것이기 때문에 새로이 region 별로 진행할 필요 없이, 확장된 Jacobian에 기존의 Jacobian을 위치시키고 추가로 Boundary condition을 고려해주는 항을 입력한다면, 기존에 임의로 고려했던 matrix의 단점을 보완할 수 있다고 생각했습니다.

1번 Structure



Region

Red, Green region : Oxide (3.9) , Region 1, 3

White region : Silicon (11.7), Region 2

Interface vertex

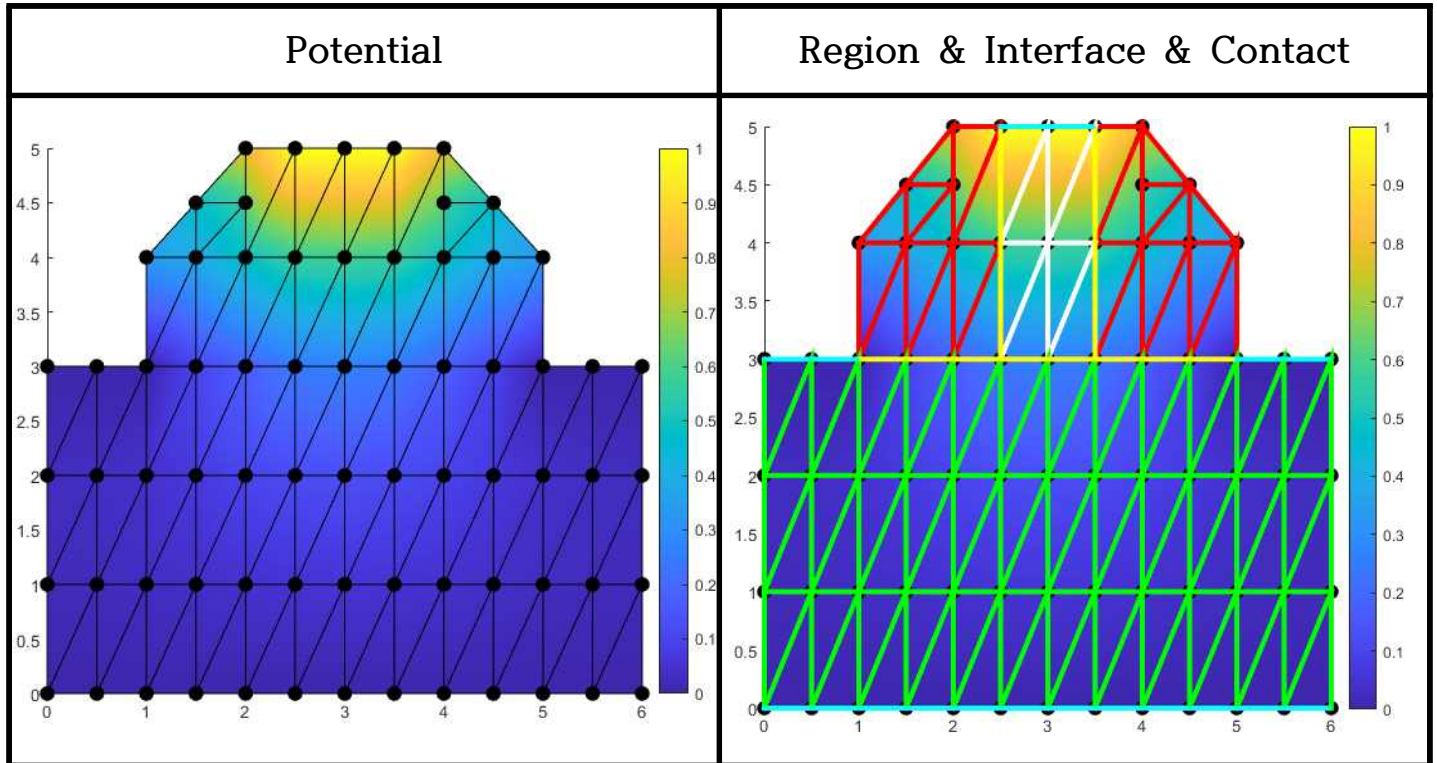
Interface Vertex 수 : 총 6 개 (8,9,10 / 18,19,20)

전체 Jacobian 수 : $27 + 6 = 33 * 33$ matrix

Results

Jacobian	Potential																																																																																																
1번 Interface (8,9,10 Si, 11,12,13 Oxide flux)	8, 9, 10 / 21, 22, 23 : Si 실제 값을 대입 나머지, B.C 따라서 두 값이 동일하다.																																																																																																
<table><tr><td>3.9000</td><td>0</td><td>0</td><td>5.8500</td><td>-31.2000</td><td>9.7500</td><td>5.8500</td><td>-23.4000</td><td>5.8500</td><td>11.7000</td><td>0</td><td>0</td><td>11.7000</td></tr><tr><td>0</td><td>7.8000</td><td>0</td><td>0</td><td>9.7500</td><td>-39.0000</td><td>9.7500</td><td>5.8500</td><td>-23.4000</td><td>5.8500</td><td>11.7000</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>3.9000</td><td>0</td><td>0</td><td>9.7500</td><td>-31.2000</td><td>5.8500</td><td>5.8500</td><td>-23.4000</td><td>5.8500</td><td>11.7000</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr></table>	3.9000	0	0	5.8500	-31.2000	9.7500	5.8500	-23.4000	5.8500	11.7000	0	0	11.7000	0	7.8000	0	0	9.7500	-39.0000	9.7500	5.8500	-23.4000	5.8500	11.7000	0	0	0	0	3.9000	0	0	9.7500	-31.2000	5.8500	5.8500	-23.4000	5.8500	11.7000	0	0	0	0	0	-1	0	0	1	0	0	0	0	0	0	0	0	0	0	-1	0	0	1	0	0	0	0	0	0	0	0	0	0	-1	0	0	1	0	0	0	21 0.2471 22 0.2452 23 0.2552 24 0.2471 25 0.2452 26 0.2552 27 0.2717 28 0.2707 29 0.2793 30 0.2839 31 0.2859 32 0.2882 33 0.2931 34 0.3094 35 0.3253 36 0.3163 37 0.3094 38 0.3253 39 0.3163																		
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2번 Structure



Region

Red_right,_left region : Oxide (3.9) , Region 1, 2

Green, White region : Silicon (11.7), Region 3

Interface vertex

Interface Vertex 수 : 총 12 개 (yellow line)

전체 Jacobian 수 : $70 + 12 = 82 * 82$ matrix

총 4가지 구역으로 생각하여 결과를 나눴습니다.

모든 Device에 대해서 적용하기 위해서는 일반화가 필요한데, 저의 코드는 현재 일반화가 되어있지 않고, 실제 수를 입력하여 Jacobian의 index를 수정하였습니다. 따라서, 다른 structure에 대해서는 풀지 못하고 있으며, 본 코드 역시 수작업으로 값을 적어야 하는 문제가 있어 수정이 필요하다고 생각합니다.

Results

Jacobian																				Potential																																																																																																																																																																	
<table><tr><td>5.8500</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-4.8750</td><td>3.9000</td><td>0</td><td>11.7000</td><td>-29.2500</td><td>11.7000</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>5.8500</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3.9000</td><td>-9.7500</td><td>3.9000</td><td>0</td><td>11.7000</td><td>-29.2500</td><td>11.7000</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>5.8500</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3.9000</td><td>-9.7500</td><td>3.9000</td><td>0</td><td>11.7000</td><td>-29.2500</td><td>11.7000</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>5.8500</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3.9000</td><td>-4.8750</td><td>0</td><td>0</td><td>11.7000</td><td>-43.8750</td><td>23.4000</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr></table> <p>1번 Interface (42,43,44,45)</p>																				5.8500	0	0	0	0	0	0	0	0	0	-4.8750	3.9000	0	11.7000	-29.2500	11.7000	0	0	0	0	0	5.8500	0	0	0	0	0	0	0	0	3.9000	-9.7500	3.9000	0	11.7000	-29.2500	11.7000	0	0	0	0	0	5.8500	0	0	0	0	0	0	0	0	3.9000	-9.7500	3.9000	0	11.7000	-29.2500	11.7000	0	0	0	0	0	5.8500	0	0	0	0	0	0	0	3.9000	-4.8750	0	0	11.7000	-43.8750	23.4000	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	1	0	0	42	1.0750
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