**פרויקט מחשב בשדות אלקטרומגנטיים:**

לחישוב הנתונים השתמשנו בת.ז. של ערן:

נתונים:

* בעל מוליכות סופית
* אינסופי ואינווריאנטי בכיוון Z
* המבנה במישור XY וממלא את התחום
* מיקומי מרכז האלקטרודות:
  1. פילוג פוטנציאל וזרם חשמלי:

מיקום אלקטרודות: (m,n)=(3,2)

נגדיר המרה של מרחקים: (מספר נקודות)

את תנאי שפה נחלק לתחומים הבאים:

* ב- y=a נשתמש בתנאי שפה נוימן
* ב- x=a נשתמש בתנאי שפה נוימן
* ב- אנחנו נמצאים על האלקטרודה אשר בה אנחנו יודעים את ערך הפוטנציאל , , ונשתמש בתנאי שפה דיריכלה
* ב- אנחנו נמצאים על אלקטרודת האדמה אשר בה אנחנו יודעים את ערך הפוטנציאל , , ונשתמש בתנאי שפה דירכלה
* ב- נשתמש בתנאי שפה נוימן
* ב- נשתמש בתנאי שפה נוימן
* בכל המקומות האחרים אנחנו בתוך התחום ולכן ניעזר במשוואת לפלס

באמצעות המשוואות מתנאי שפה אלו אנחנו מגיעים למטריצה על ערכי הפוטנציאל בכל נקודת דגימה, בעזרת הקרובים ובניית מערכת משוואות מטריציונית (בעזרת קירוב הנגזרות כאשר השתמשנו בקירוב של נגזרת קדמית/אחורית בהתאם לשפה).

* הכנסנו למטריצת מקדמי הפוטנציאל ערכים סקלרים בהתאם למשוואת תנאי השפה המתקיימת באותו מקום
* בנוסף הוספנו את הערכים המתאימים לוקטור הפתרונות:

לבסוף על מנת לגלות את וקטור הכפלנו משמאל במטריצה ההופכית של מטריצת המקדמים:

ובעזרת משוואות אלו קיבלנו את הפוטנציאל.

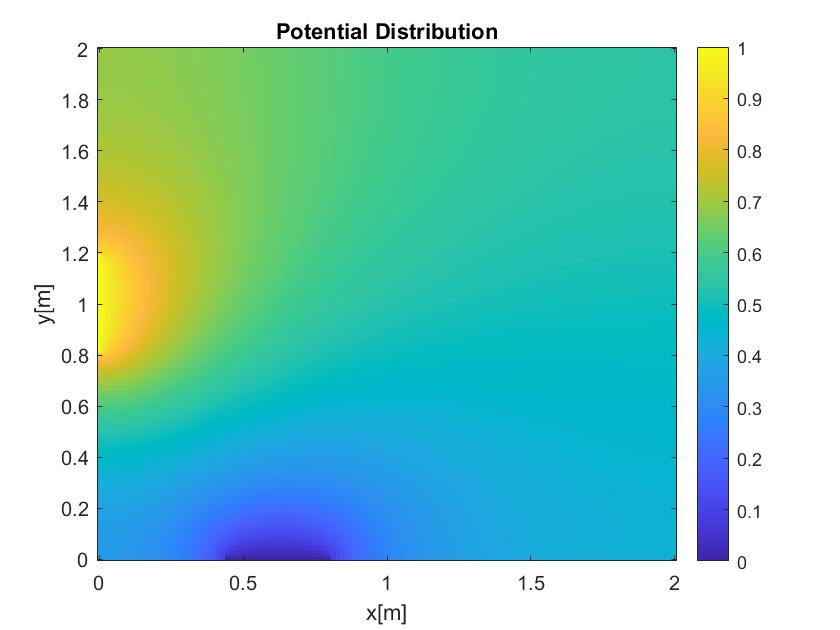
חישוב הזרמים נעשה באמצעות הנוסחאות הבאות:

נחשב ונקבל:

לבסוף נבצע:

* את J חישבנו באמצעות פונקציית הגרדיאנט המובנית של מאטלב לפי גודל צעד של h.

**גרף הפוטנציאלים:**

* ניתן לראות את הפוטנציאל הנמוך ליד האלקטרודה אשר מחוברת לאדמה ואת הפוטנציאל הגבוה ליד האלקטרודה המחוברת ל-V0
* תמונה שמכילה טקסט, לוח ציור

  התיאור נוצר באופן אוטומטיכדי לבדוק את מידת הדיוק המוערכת של הפתרון, חישבנו את שגיאת ה-RMS לפי:

כאשר בחרנו את מספר הנקודות להיות 70 ו-140 ומצאנו שהשגיאה היחסית היא 0.0233 כלומר 2.33% כלומר זו היא שגיאה קטנה ונסיק מכך שהרזולוציה שנבחרה מתאימה למטרתנו.

* 1. בסעיף זה עלינו לחשב את האימפדנס בין אלקטרודת המתח לאלקטרודת האדמה.

נחשב פוטנציאל עבור כל שילוב (m,n) בעזרת הפונקציה בה השתמשנו בסעיף א, לאחר מכן נחשב את כמו בסעיף הקודם.

נרוץ על המטריצות, נסכום את הזרם הנכנס באלקטרודה אחת ואת הזרם היוצא מהאלקטרודה השנייה ונבצע ממוצע כאשר כפלנו ב-h (ביחידות של [m]) בכל איטרציה כדי לעבור מיחידות של לחידות , סה"כ:

* כדי למצוא את האימפדנס המתאים בכל שילוב, עבור כל m,n נכניס למטריצת אימפדנסים Z(m,n) כאשר כל איבר במטריצה יחושב לפי
* בנוסף חישבנו מטריצה שבה כל איבר מייצג את השגיאה היחסית משימור הזרם עבור כל (m,n) לפי:

![תמונה שמכילה שולחן

התיאור נוצר באופן אוטומטי](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAkACQAAD/4RDcRXhpZgAATU0AKgAAAAgABAE7AAIAAAAGAAAISodpAAQAAAABAAAIUJydAAEAAAAMAAAQyOocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAE1vcmFuAAAFkAMAAgAAABQAABCekAQAAgAAABQAABCykpEAAgAAAAM0MAAAkpIAAgAAAAM0MAAA6hwABwAACAwAAAiSAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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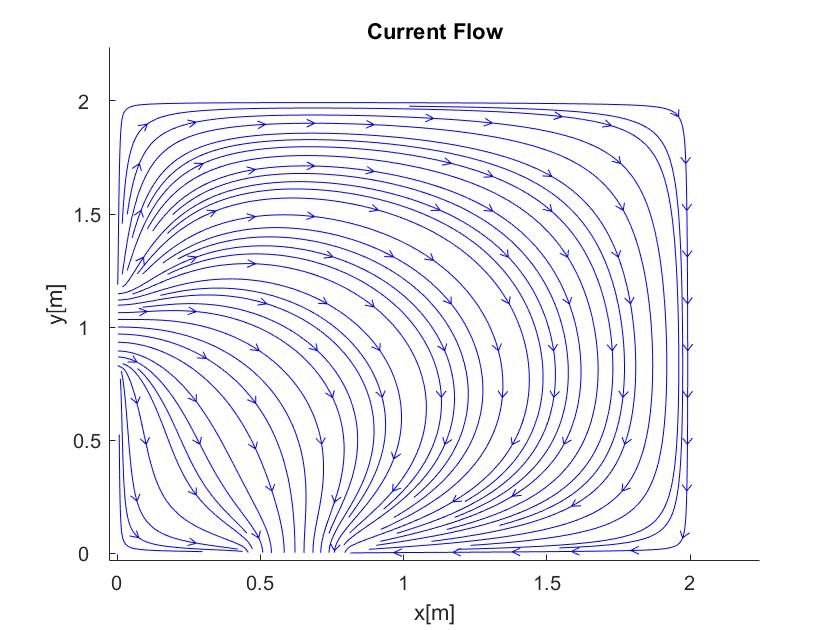
* נבחין שמטריצת האימפדנסים סימטרית לחלוטין כצפוי מהמבנה הסימטרי של הבעיה

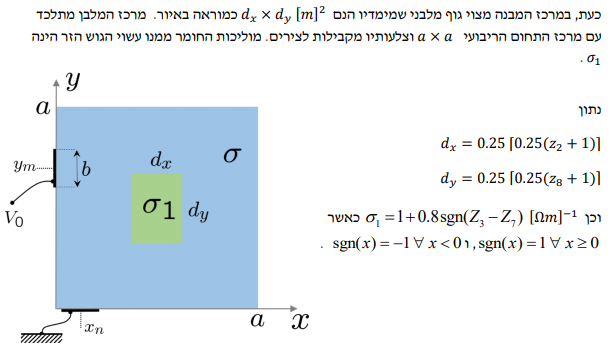
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אוטומטי](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAkACQAAD/4RCERXhpZgAATU0AKgAAAAgABAE7AAIAAAAGAAAISodpAAQAAAABAAAIUJydAAEAAAAMAAAQcOocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAE1vcmFuAAAB6hwABwAACAwAAAhiAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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שימור הזרם:**

נבחין שבקירוב טוב מאוד, שימור הזרם מתקיים עבור כל המיקומים של האלקטרודות

**גרף הזרמים:**

נשים לב שהזרם זורם מהפוטנציאל הגבוה לפוטנציאל הנמוך, כצפוי.

1. שאלה 2

תחום המוליך הוא:

* 1. הפוטנציאל משתנה עקב השינוי בתנאי השפה החדשים שקיימים בבעיה

סה"כ נסדר ונקבל:

אם נבחר שלוש נקודות כלשהן - כאשר האמצעית נמצאת על שפת הגוף הזר והשתיים האחרות משני צדדיה אז קירוב הנגזרת יתבצע לפי:

1. שפה שמאלית:
2. שפה ימנית:
3. שפה עליונה:
4. שפה תחתונה:

נכניס את כל הנתונים שקיבלנו:

חישבנו את D באמצעות הנוסחה הנתונה:

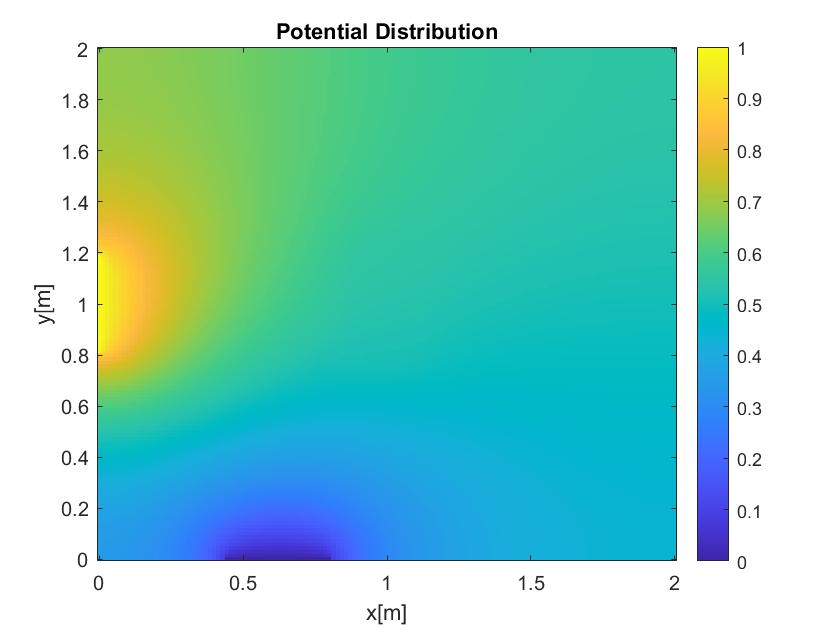
קיבלנו **D=0.1237**

**מטריצת האימפדנסים:** תמונה שמכילה שולחן

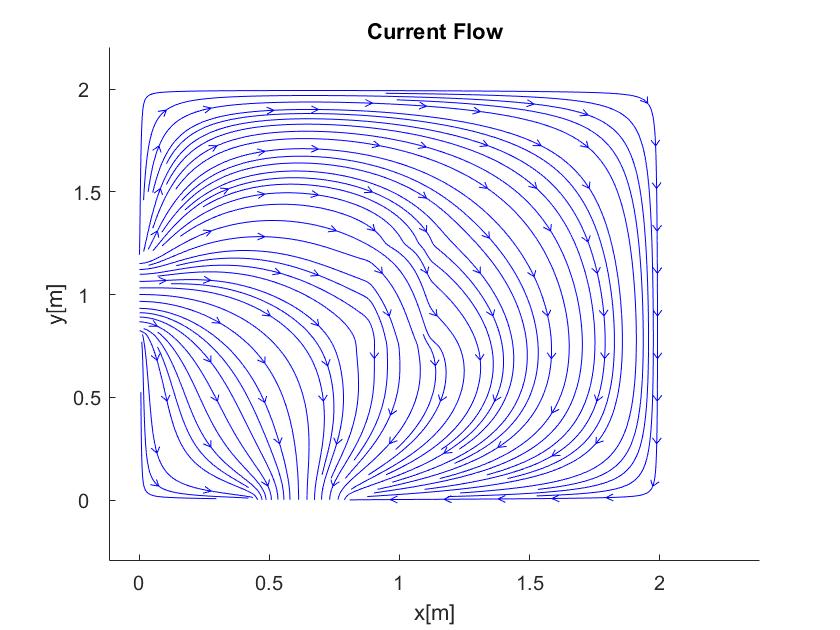
התיאור נוצר באופן אוטומטי

* קיבלנו מטריצת אימפדנסים שאינה סימטרית עקב כך ש ולכן למשל המיקום (5,1) ייתן אימפדנס שונה מעט מהמיקום (5,1).
* ערכי האימפדנס במטריצת האימפדנסים קטנים יותר כצפוי מכיוון ש נקבל שהמוליכות הכוללת תגדל ולכן האימפדנס יקטן.
* ערכו של D משמש כאינדיקטור על ההבדלים בין האימפדנסים במצב בו אין לוחית בשאלה, למצב בו יש לוחית בשאלה (הבדלים בין סעיף זה לשאלה 1.2) כלומר כיצד הלוחית משפיע על הבעיה.
* קיבלנו שערכו של D הוא בגודל של בערך סדר גודל אחד ביחס לערכי האימפדנס, וניתן לומר שאכן הוא מהווה אינדיקטור טוב לקיום הגוף הזר במקרה זה.

**גרף התפלגות הפוטנציאל:**

קשה להבחין בשינוי בפוטנציאל, על אף שהשינוי קיים וניכר בהתפלגות הזרמים.

**התפלגות הזרם:**

נשים לב לעיוות הזרמים בתחום בו נמצאת הלוחית, דבר הנובע מהשינוי במקדם המוליכות – הזרם נוטה לסטות לכיוון הלוחית כצפוי עקב המוליכות הגבוהה שלה ביחס ללוחית.

**מטריצת שימור הזרם:**

עדיין שימור הזרם מתקיים בקירוב טוב, אך פחות מהשאלה הקודמת. ההשערה שלנו היא שהסיבה לכך היא שהוספנו עוד אלמנט של קירוב שהוביל לירידה בדיוק הפתרון הנומרי.

תמונה שמכילה שולחן

התיאור נוצר באופן אוטומטי

* 1. כעת מרכז המלבן נמצא בנקודה .

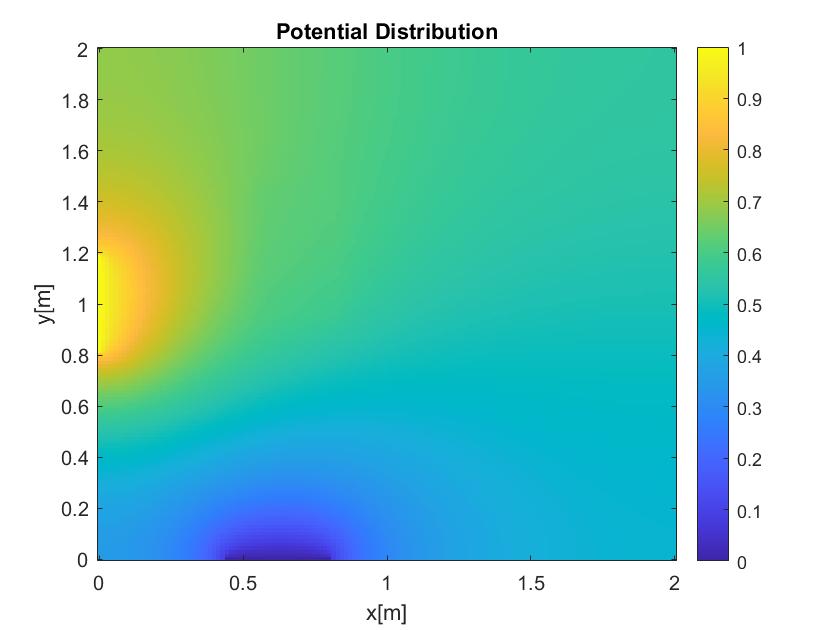
עקב העובדה שהגוף כבר לא ממורכז מטריצת האימפדנסים מאבדת יותר מהאופי הסימטרי שהיה לה.

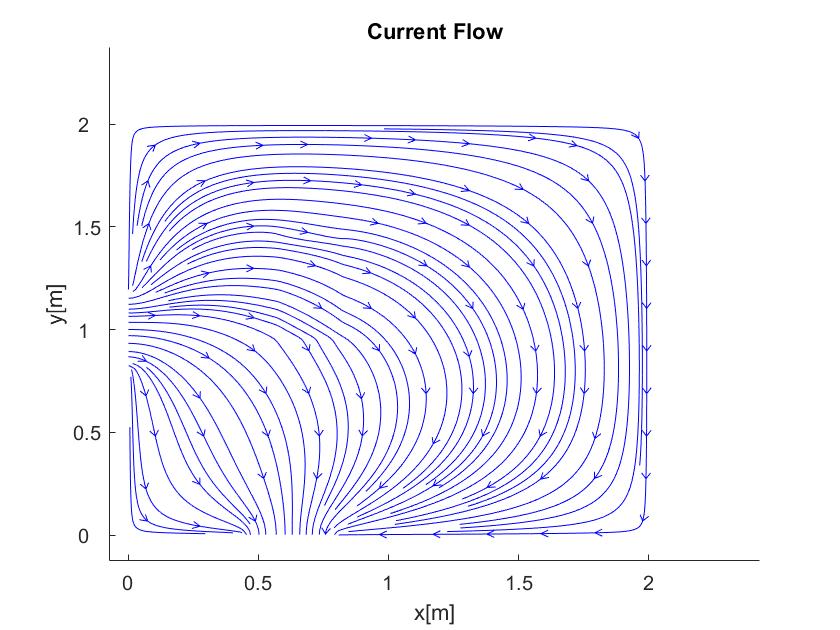
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**מטריצת האימפדנסים:** תמונה שמכילה שולחן

התיאור נוצר באופן אוטומטי

נשים לב שיש עליה בערך האימפדנס במקומות בהן האלקטרודות מרוחקות אחת מן השנייה (למשל במיקום (5,5) יש עליה משמעותית). הסיבה לכך היא שעבור מיקומי אלקטרודות אלו פחות זרם יחלוף דרך הגוף הזר. נשים לב שגם יש ירידה בערך האימפדנס עבור מקרים בהם האלקטרודות יותר קרובות זו לזו (למשל במיקום (1,3)) משום שבמקרים אלו יותר זרם יחלוף דרך הגוף הזר. משום שהעלייה בערך האימפדנסים מובילה לכך שהאמפנסים יותר קרובים למקרה ללא הגוף אנו רואים את הירידה בערך D.

**גרף התפלגות הפוטנציאל:**

**התפלגות הזרם:** 

* גם כאן נקבל את העיוותים בזרמים עקב הקפיצה בין אזורים עם מקדמי הולכה שונים במיקום הגוף הזר.

**מטריצת שימור הזרם:**

תמונה שמכילה שולחן

התיאור נוצר באופן אוטומטיגם גם הפעם נשים לב ששימור הזרם נשמר בקירוב טוב.

* 1. כעת התחום הקודם (במצבו הממורכז) הוקף בשכבה הצמודה אליו בעלת מוליכות:

ובעובי:

התקבל

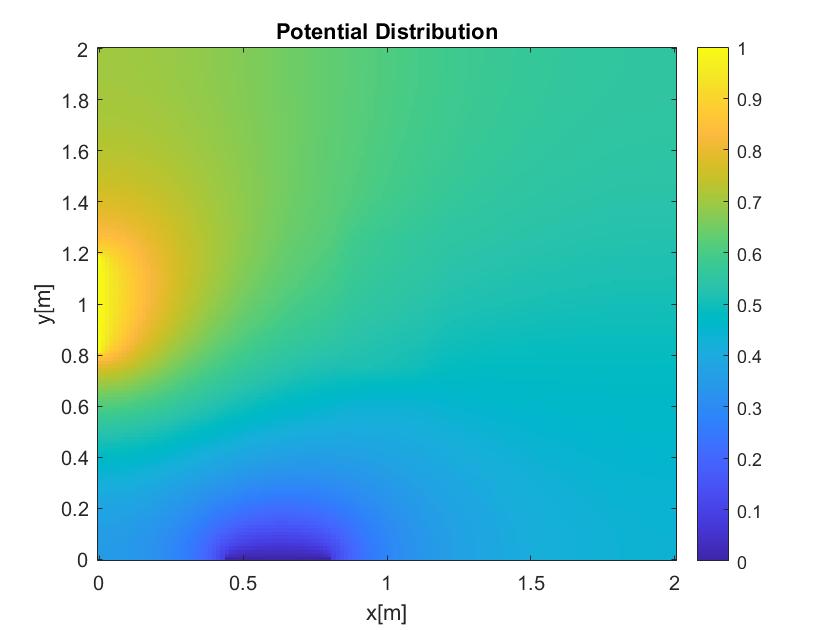
קיבלנו שערכו של D גבוה מערכו במקרה ללא הציפוי.

השערתנו היא שעליה זו נובעת מכך ששטח הציפוי של הגוף הזר גדול פי 1.56 משטח הגוף עצמו (שטח של 0.195 של ציפוי מול שטח של [0.125 של הגוף עצמו). לכן הסקנו שהציפוי מעלה יותר את האימפדנס הכולל עקב המוליכות הנמוכה שלו ושטחו הגדול, מאשר ההורדה של האימפדנס עקב הגוף הזר. לשם אישוש ההשערה, ביצענו בדיקת שפיות ולקחנו (במקום כפל ב-0.3 הנתון בסעיף) ואכן קיבלנו D=0.129 כלומר אכן עבור ציפוי קטן יותר נקבל פער קטן יותר.

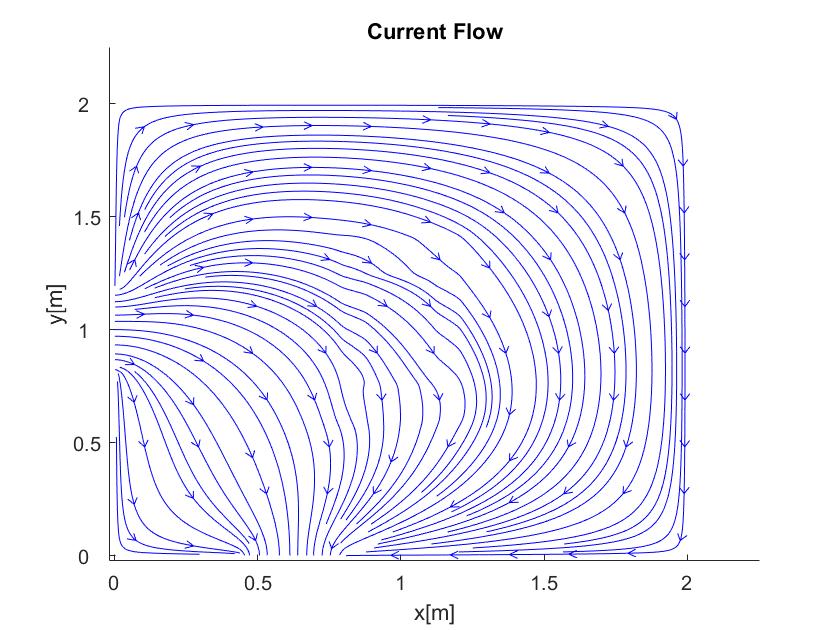
**מטריצת אימפדנסים:** תמונה שמכילה שולחן

התיאור נוצר באופן אוטומטי

פה אנחנו מבחינים בעלייה בערכי האימפדנס, כאשר הנימוקים שנימקנו עבור עליית ערך D מסבירים זאת.

**גרף התפלגות הפוטנציאל:** 

ניתן להבחין בירידה הקטנה (אם ממש מתאמצים) בערך הפוטנציאל בתחום הגוף הזר במרכז

**התפלגות הזרם:** 

* נשים לב לעיוות המתרחש במעבר לתחום המסגרת המקיפה את הלוחית ולאחר מכן לעוד עיוות הנובע מעוד מעבר אל הלוחית עצמה. נבחין גם בכך שישנם פחות קווי זרם בתחום בו הזרמים חוצים את הציפוי בלבד מכיוון שההתנגדות שם גבוהה יותר (ראינו לפי ערכו של D) ולכן פחות זרם זורם לשם.

**מטריצת שימור הזרם:** תמונה שמכילה שולחן

התיאור נוצר באופן אוטומטי

שוב, קיים שימור זרם עם סטייה קטנה.