

## Metody Obliczeniowe w Nauce i Technice

#### Sprawozdanie | Układy równań liniowych - metody bezpośrednie cz.2

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### 1. Omówienie przypadku

Dana jest trójdiagonalna macierz liczb rzeczywistych zdefiniowana odpowiednio:

$$\mathbf{A_{III}}^{n \times n} = \begin{cases} a_{i,i} = k \\ a_{i,i+1} = \frac{1}{i+m} \\ a_{i,i-1} = \frac{k}{i+m+1}, & \text{dla } i > 1 \\ a_{i,j} = 0, & \text{dla } j < i-1 \text{ oraz } j > i+1 \end{cases}$$

$$(1.1)$$

$$\text{dla } m = 3, k = 7$$

, gdzie:

- i numer wiersza macierzy
- j numer kolumny macierzy
- n wymiary macierzy

W niniejszym dokumencie przeprowadzono analizę numerycznego rozwiązywania układów równań liniowych postaci  $\mathbf{A}\mathbf{x}=\mathbf{b}$ , **metodą eliminacji Gaussa** oraz **metodą Thomasa** gdzie  $\mathbf{A}$  jest **trójdiagonalną macierzą** współczynników,  $\mathbf{x}$  wektorem niewiadomych, a  $\mathbf{b}$  wektorem wyrazów wolnych. Celem pracy jest zbadanie wpływu użycia różnych metod rozwiązywania układu na dokładność otrzymanych rozwiązań, poprzez **wyznaczenie błędów** pomiędzy wyznaczonymi a prawdziwymi wartościami wektora niewiadomych, **czas rozwiązania** układu oraz **zużycie pamięci** przez metodę.

W zadaniu zbadano rozwiązywanie układu rownań dla n=2,...,500 oraz **dwóch precyzji obliczeń** oferowanych przez bibliotekę numpy: float32 (pojedyńcza precyzja) oraz float64 (podwójna precyzja). Dodatkowo, testy przeprowadzono na macierzy  ${\bf A_{III}}$  reprezentowanej w sposób dwojaki:

- W pełnej formie macierzy  $\mathbf{A_{III}}^{n \times n}$  ( Równanie (1.1) ) (metoda Gaussa oraz metoda Thomasa)
- W formie przechowującej jedynie liczby na diagonali oraz paśmie szerokości 3 macierzy:

$$\mathbf{A_{III}}^{n \times 3} = \begin{cases} a_{i,2} = k \\ a_{i,3} = \frac{1}{i+m}, & \text{dla } i < n \\ a_{i,1} = \frac{k}{i+m+1}, & \text{dla } i > 1 \\ a_{i,j} = 0, & \text{wpp.} \end{cases}$$

$$i = 1, ..., n, \quad j = 1, 2, 3$$

$$(1.2)$$

Druga metoda przechowywania macierzy jest możliwa, ponieważ  $\mathbf{A}_{\mathbf{III}}$  jest macierzą rzadką, trójdiagonalną, przez co większość jej elementów  $a_{ij}=0$ .

### 2. Metodyka wyznaczania układów równań

W celach badania wprowadzony został wektor rzeczywisty

$$\overline{\mathbf{x}}^{n \times 1} = \begin{bmatrix} 1 \\ -1 \\ \vdots \\ -1 \\ 1 \end{bmatrix}$$
 (2.1)

, gdzie n zdefiniowane jest jak powyżej, zaś elementy wektora są losową kombinacją liczb -1 i 1. W eksperymencie, w celu uzyskania powtarzalnych wyników, zawsze ustawiano random. seed na stałą wartość podczas generowania wektora.

Z powyższego wektora otrzymywano wektor b w następujący sposób:

$$\mathbf{b} = \mathbf{A}\overline{\mathbf{x}} \tag{2.2}$$

Następnie, mając wyznaczony wektor  $\mathbf{b}$  przystąpiono do rozwiązywania układu równań  $\mathbf{A}\mathbf{x} = \mathbf{b}$ , gdzie  $\mathbf{x}$  jest wektorem niewiadomych.

Podejście to umożliwiło porównanie wyznaczonego wektora x do  $\overline{x}$ .

### 3. Pomiar poprawności wyznaczenia rozwiązania

Pomiar poprawności wyznaczenia rozwiązania układu równań przeprowadzony został, porównując prawdziwe składowe wektora z wartością metodą Gaussa. Za metrykę błędu przyjęty został **błąd bezwzględny**.

$$\|\mathbf{x}\|_{\max} = \max_{i \in 1, \dots, n} (|x_i - \overline{x_i}|) \tag{3.1}$$

, gdzie

- $x_i$  i-ta wartość wyznaczonego wektora
- $\overline{x_i}$  *i*-ta wartość prawdziwego wektora

### 4. Wyznaczenie zużycia pamięci

Zużycie pamięci przez użyte metody zostało zbadane za pomocą biblioteki wbudowanej tracemalloc języka Python z użyciem metod take\_snapshot, snapshot.compare\_to oraz zsumowaniem różnicy w statystykach zaalokowanej pamięci pomiędzy obiektami snapshot.

#### 5. Dane techniczne

Zadanie zostało przeprowadzone z użyciem narzędzi o następujących parametrach:

- Komputer HP EliteBook 840 G6:
  - ► System operacyjny: Windows 11 x64
  - ► Procesor Intel(R) Core(TM) i5-8365U CPU 1.60GHz 1.90 GHz
  - ► Pamięć RAM: 8GB
- Środowisko: Jupyter Notebook
- Język: Python 3.12.0
- Biblioteki języka: Numpy, Pandas, Matplotlib, Seaborn



# 6. Analiza wyników dla macierzy $\mathbf{A}_{\mathrm{III}}$

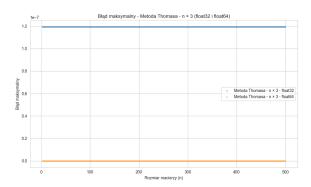
# 6.1. Błąd makysmalny $\|\mathbf{x}\|_{\max}$

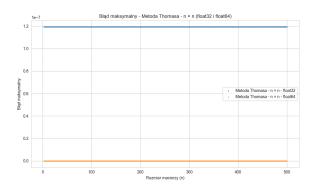
		błędu makysma Precyzja float3	2		Precyzja float6	1
	$\mathbf{A_{III}}^{n \times 3}$	$\mathbf{A_{III}}^{n \times n}$	$\mathbf{A_{III}}^{n \times n}$	$\mathbf{A_{III}}^{n \times 3}$	$\mathbf{A_{III}}^{n \times n}$	$\mathbf{A_{III}}^{n \times n}$
n	Metoda	Metoda	Metoda	Metoda	Metoda	Metoda
_	Thomasa	Thomasa	Gaussa	Thomasa	Thomasa	Gaussa
2	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
3	1.1921e-07	0.0000e+00	1.1921e-07	0.0000e+00	1.1921e-07	0.0000e+00
4	1.1921e-07	2.2204e-16	1.1921e-07	0.0000e+00	1.1921e-07	0.0000e+00
5	1.1921e-07	2.2204e-16	1.1921e-07	0.0000e+00	1.1921e-07	0.0000e+00
6	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
7	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
8	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
9	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
10	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
11	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
$\overline{}$						
12	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
13	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
14	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
15	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
16	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
17	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
18	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
19	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
20	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
21	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
22	1.1921e-07	2.2204e-16	1.1921e-07	1.1102e-16	1.1921e-07	1.1102e-16
23	1.1921e-07	2.2204e-16 2.2204e-16	1.1921e-07 1.1921e-07	1.1102e-16	1.1921e-07 1.1921e-07	1.1102e-16
				1.1102e-16		
24	1.1921e-07	2.2204e-16	1.1921e-07		1.1921e-07	1.1102e-16
25	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
26	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
27	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
28	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
29	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
30	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
31	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
32	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
33	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
34	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204c-16
_						
35	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
36	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
37	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
38	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
39	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
40	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
41	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
42	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
43	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
44	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
45	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
46	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
47	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
48	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
48	1.1921e-07	3.3307e-16	1.1921e-07 1.1921e-07	2.2204e-16 2.2204e-16	1.1921e-07 1.1921e-07	2.2204e-16 2.2204e-16
50	1.1921e-07	3.3307e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
				I		
251	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
252	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
253	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
254	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
255	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
256	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
257	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
258	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
259	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
260	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
261	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
262	1.1921e-07	4.4409e-16	1.1921e-07	2.2204c-16	1.1921e-07	2.2204e-16
-					1.1921e-07 1.1921e-07	2.2204e-16 2.2204e-16
263	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16		
264	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
265	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
266	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
267	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
268	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
269	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
270	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
271	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
-	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204c-16
272 I	1.1/210-07	1.11070-10				
	1 1001 - 07	4.4400~ 47				
273	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
273 274	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
272 273 274 275 276						

March   Meriods   Meriod	$\vdash$		błędu makysma Precyzja float32			ktora dla macie Precyzja float64	
Metoda   Metoda   Metoda   Metoda   Thomasa   Thomasa	$\vdash$						$\mathbf{A_{III}}^{n \times n}$
1.1921e07	n	Metoda	Metoda	Metoda	Metoda	Metoda	Metoda
278		Thomasa	Thomasa	Gaussa	Thomasa	Thomasa	Gaussa
1.1921e-07	277	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
280	278	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
281   1.1921e-07	279	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
282	280	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
283	281	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
284   1.1921e-07	282	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
285	283	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
286   1.1921e-07	284	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
287   1.1921e-07	285	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
288   1.1921e-07	286	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
289   1.1921e-07	287	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
200	288	1.1921e-07	4.4409e-16	1.1921e-07		1.1921e-07	2.2204e-16
1.1921e-07	-	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
1921-07	290	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
293   1.1921e-07	$\vdash$						2.2204e-16
294   1.1921e-07	-						2.2204e-16
295   1.1921e-07							2.2204e-16
296   1.1921e-07	-						2.2204e-16
277   11921e-07	-						2.2204e-16
298   1.1921e-07							2.2204e-16
1.1921e-07	-						2.2204e-16
1.1921e-07							2.2204e-16
Section	-						2.2204e-16 2.2204e-16
451   1.1921e-07	300	1.19216-07	4.44090-16		2.22U4e-16	1.19210-0/	2.2204e-16
Associated   Ass	451	1.1921e-07	4.4409e-16		2.2204e-16	1.1921e-07	2.2204e-16
453   1.1921e-07	$\vdash$						2.2204e-16
454   1.1921e-07	453			1.1921e-07			2.2204e-16
456	454		4.4409e-16				2.2204e-16
457   1.1921e-07	455	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
455   1.1921e-07	456	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
459	457	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
460	458	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
461   1.1921e-07	459	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
462	460	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
463	461	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
464   1.1921e-07	462	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
465   1.1921e-07	463	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
1.1921e-07	$\vdash$						2.2204e-16
467   1.1921e-07	100						2.2204e-16
468         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           469         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           470         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           471         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           472         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           473         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           475         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           476         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           477         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           478         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480	-						2.2204e-16
1.1921e-07	_						2.2204e-16 2.2204e-16
1.1921e-07	100						2.2204e-16 2.2204e-16
471         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           472         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           473         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           474         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           475         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           476         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           477         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           479         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483	-						2.2204e-16 2.2204e-16
472         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           473         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           474         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           475         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           476         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           477         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           478         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           479         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483	-						2.2204e-16 2.2204e-16
473         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           474         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           475         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           476         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           477         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           478         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           479         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485	$\vdash$						2.2204e-16 2.2204e-16
1.1921e-07	-						2.2204e-16 2.2204e-16
475         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           476         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           477         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           482         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           484         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           486         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           487							2.2204e-16
476         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           477         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           478         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           479         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           482         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           486	-						2.2204e-16
477         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           478         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           479         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           482         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           484         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           486         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           487	-						2.2204e-16
478         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           479         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           482         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           486         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           487         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           488         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           490	-						2.2204e-16
479         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           480         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           482         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           486         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           488         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           490	478				2.2204e-16	1.1921e-07	2.2204e-16
481         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           482         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           483         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           484         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           486         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           487         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           489         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           491         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493	479	1.1921e-07		1.1921e-07		1.1921e-07	2.2204e-16
482   1.1921e-07	480	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
483   1.1921e-07	481	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
484         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           485         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           486         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           487         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           488         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           490         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           491         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495	482	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
485   1.1921e-07	-						2.2204e-16
486	-						2.2204e-16
487         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           488         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           489         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           490         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           491         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497	_						2.2204e-16
488         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           489         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           490         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           491         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	-						2.2204e-16
489         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           490         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           491         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	-						2.2204e-16 2.2204e-16
490         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           491         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	-						
491         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	-						2.2204e-16 2.2204e-16
492         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	-						2.2204e-16 2.2204e-16
493         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	$\vdash$						2.2204e-16
494         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	-						2.2204e-16 2.2204e-16
495         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	$\vdash$						2.2204e-16
496         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22           497         1.1921e-07         4.4409e-16         1.1921e-07         2.2204e-16         1.1921e-07         2.22	-						2.2204e-16
497 1.1921e-07 4.4409e-16 1.1921e-07 2.2204e-16 1.1921e-07 2.22	-						2.2204e-16
498 1.1921e-07 4.4409e-16 1.1921e-07 2.2204e-16 1.1921e-07 2.22	497						2.2204e-16
	498	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
499 1.1921e-07 4.4409e-16 1.1921e-07 2.2204e-16 1.1921e-07 2.22	499	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16
500 1.1921e-07 4.4409e-16 1.1921e-07 2.2204e-16 1.1921e-07 2.22	500	1.1921e-07	4.4409e-16	1.1921e-07	2.2204e-16	1.1921e-07	2.2204e-16



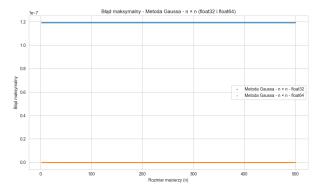
# 6.2. Wizualizacja wyników błędu makysmalnego $\|\mathbf{x}\|_{\max}$



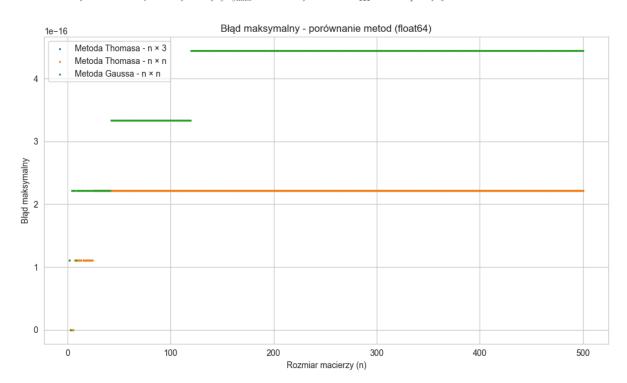


Rysunek 1: Błąd maksymalny  $\|\mathbf{x}\|_{\max}$  dla metody Thomasa  $\mathbf{A_{III}}^{n\times 3}$  dla precyzji float<br/>32 oraz float<br/>64.

Rysunek 2: Błąd maksymalny  $\|\mathbf{x}\|_{\max}$  dla metody Thomasa  $\mathbf{A_{III}}^{n \times n}$  dla precyzji float32 oraz float64.



Rysunek 3: Błąd maksymalny  $\|\mathbf{x}\|_{\max}$  dla metody Gaussa  $\mathbf{A_{III}}^{n \times n}$  dla precyzji float<br/>32 oraz float<br/>64.



Rysunek 4: Porównanie błędów maksymalnych  $\|\mathbf{x}\|_{\max} \; \mathbf{A}_{\mathbf{III}}$ różnymi metodami dla precyzji float<br/>64.



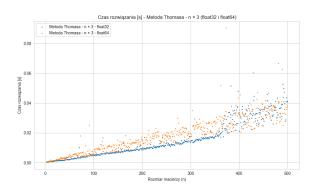
## 6.3. Czas rozwiązywania układu równań

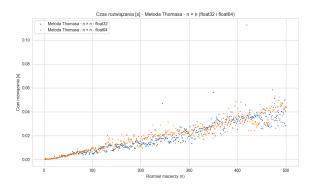
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Precyzja float6  A <sub>III</sub> <sup>n×n</sup> Metoda	$\mathbf{A_{III}}^{n \times n}$
n Metoda Metoda Metoda Thomasa Thomasa Gaussa Thomasa	Metoda	AIII
		Metoda
2 4.2460e-04 5.0000e-04 3.0140e-04 4.5060e-04	Thomasa	Gaussa
	2.6290e-04	4.1190e-04
3 8.9630e-04 7.6380e-04 1.2262e-03 3.7650e-04	5.1680e-04	6.1580e-04
4 8.1470e-04 1.8197e-03 4.3050e-04 3.9480e-04	7.5090e-04	5.3450e-04
5 1.2045e-03 1.6766e-03 4.3720e-04 5.7160e-04	4.8630e-04	5.7080e-04
6 1.5970e-03 2.0474e-03 8.2650e-04 4.8360e-04	9.9100e-04	6.3990e-04
7 2.2251e-03 2.5946e-03 4.8620e-04 6.5260e-04	8.0490e-04	7.0920e-04
8 3.6530e-03 3.0731e-03 5.0670e-04 4.8760e-04	5.9130e-04	7.9070e-04
9 3.488e-03 3.7363e-03 5.3600e-04 5.5370e-04	8.8370e-04	8.7870e-04
10 3.8324e-03 4.6240e-03 5.5690e-04 5.8990e-04	1.7756e-03 7.8930e-04	9.6480e-04
11 5.4826e-03 5.3276e-03 6.2850e-04 8.6640e-04		1.0732e-03
12 5.4341e-03 6.0083e-03 7.2590e-04 7.9100e-04 13 8.4784e-03 6.8752e-03 7.6650e-04 7.2430e-04	7.1140e-04 8.0700e-04	1.2164e-03 1.1823e-03
	,	
14     1.0057e-02     7.9665e-03     9.4140e-04     7.5060e-04       15     1.1608e-02     9.2601e-03     1.1395e-03     9.8190e-04	8.6420e-04 8.8680e-04	1.2510e-03 1.3231e-03
16 1.2464e-02 1.1924e-02 1.1285e-03 8.8020e-04	9.3730e-04	1.4063e-03
17 1.4499e-02 1.1038e-02 9.3070e-04 9.5470e-04	1.0242e-03	1.4966e-03
18 1.6134e-02 1.4128e-02 9.7750e-04 1.0832e-03	1.0435e-03	1.5324e-03
19 1.8326e-02 1.3774e-02 1.0223e-03 1.3310e-03	1.1246e-03	1.3946e-03
20 1.9552e-02 1.4393e-02 1.1339e-03 1.3251e-03	1.3536e-03	1.6300e-03
21 2.2137e-02 1.5438e-02 1.3087e-03 1.2250e-03	1.3780e-03	1.6954e-03
22 2.6228e-02 1.6460e-02 2.6619e-03 1.2616e-03	1.2015e-03	1.7735e-03
23 3.1521e-02 1.8598e-02 1.3090e-03 1.2000e-03	1.3104e-03	2.3567e-03
24 2.3856e-02 2.1286e-02 1.3212e-03 1.3214e-03	1.3402e-03	1.7293e-03
25 2.1715e-02 3.0184e-02 1.7233e-03 1.6842e-03	1.4621e-03	1.8775e-03
26 2.1848e-02 2.8323e-02 1.2805e-03 1.5132e-03	1.4506e-03	2.0701e-03
27 2.5389e-02 3.5954e-02 1.4472e-03 2.1790e-03	1.5985e-03	2.4111e-03
28 2.9681e-02 3.1736e-02 1.5567e-03 1.4804e-03	1.5143e-03	2.2370e-03
29 3.2058e-02 3.0589e-02 1.7227e-03 1.5861e-03	1.6016e-03	2.4815e-03
30 3.4643e-02 3.0161e-02 1.6756e-03 1.9267e-03	1.5817e-03	2.4660e-03
31 5.0350e-02 3.7468e-02 1.9031e-03 1.8464e-03	1.4760e-03	3.2737e-03
32 5.6790e-02 4.4341e-02 2.2049e-03 3.3933e-03	1.4783e-03	2.5916e-03
33 6.9208e-02 4.3880e-02 2.4443e-03 2.0670e-03	1.4508e-03	2.8639e-03
34 7.7582e-02 4.0396e-02 2.2343e-03 2.3686e-03	1.6714e-03	3.5169e-03
35 7.5292e-02 4.2918e-02 2.6917e-03 2.2155e-03	1.8615e-03	2.5467e-03
36 6.0600e-02 4.6120e-02 3.9341e-03 3.0682e-03	1.5696e-03	2.9059e-03
37 4.8947e-02 5.2350e-02 3.0740e-03 2.9496e-03	1.5900e-03	3.1257e-03
38 5.7030e-02 4.8631e-02 3.1459e-03 2.1123e-03	1.6374e-03	3.0697e-03
39 7.4773e-02 6.5283e-02 3.9566e-03 2.9407e-03	1.8091e-03	2.9605e-03
40 8.4155e-02 5.0323e-02 3.2943e-03 3.8582e-03	1.9284e-03	3.6405e-03
41 7.8616e-02 7.5885e-02 3.4323e-03 3.8054e-03	1.7592e-03	2.9849e-03
42 6.8556e-02 7.1283e-02 3.6093e-03 3.1430e-03	2.7145e-03	3.1346e-03
43 9.1388e-02 6.7305e-02 3.5328e-03 2.3114e-03	2.1250e-03	3.6713e-03
44 9.3176e-02 6.4526e-02 3.4091e-03 2.5227e-03	3.5144e-03	3.4107e-03
45 9.6171e-02 7.1256e-02 3.1608e-03 2.6463e-03	2.1245e-03	3.4319e-03
46 1.1166e-01 7.9715e-02 3.0598e-03 3.0355e-03	1.9465e-03	3.5395e-03
47 8.9366e-02 7.5101e-02 2.8453e-03 2.8996e-03	2.2282e-03	3.7851e-03
48 7.6340e-02 8.3035e-02 3.1826e-03 3.9248e-03	2.0310e-03	4.4895e-03
49 1.4534e-01 9.3416e-02 3.1937e-03 3.3087e-03	2.2280e-03	4.0932e-03
50 1.1174e-01 9.4781e-02 4.3330e-03 4.1256e-03	2.1520e-03	5.5313e-03
251 2.2852e+00 2.2256e+00 1.7833e-02 2.1560e-02	1 7407- 02	2 0202- 02
	1.7497e-02	2.0302e-02
	1.1949e-02 1.3161e-02	1.8019e-02
253 2.0678e+00 2.2672e+00 1.9066e-02 1.9316e-02 254 2.1130e+00 2.3477e+00 1.7781e-02 2.1396e-02	1.3161e-02 1.2558e-02	1.5971e-02 1.9875e-02
254 2.1130e+00 2.347/e+00 1.7/81e-02 2.1396e-02 255 2.2663e+00 2.3664e+00 1.7658e-02 2.4123e-02	1.2558e-02 1.1580e-02	1.9875e-02 1.8372e-02
256 2.2826e+00 2.3922e+00 1.5144e-02 3.1698e-02	1.1380e-02 1.2148e-02	1.7544e-02
2.57 2.2915e+00 2.3861e+00 1.4990e-02 2.0943e-02	1.2148e-02 1.1772e-02	1.6468e-02
258 2.3771e+00 2.3170e+00 1.4087e-02 2.4857e-02	1.1772e-02 1.0950e-02	1.7511e-02
259 2.3465e+00 2.4483e+00 1.4402e-02 2.1072e-02	1.2306e-02	1.4962e-02
260 2.4385e+00 2.3573e+00 1.5695e-02 1.3482e-02	1.2621e-02	2.0705e-02
261 2.3720e+00 2.4902e+00 1.5216e-02 2.0899e-02	1.2031e-02	2.0684e-02
262 2.3855e+00 2.4307e+00 1.4866e-02 2.3078e-02	1.2206e-02	1.7608e-02
263 2.3860e+00 2.5833e+00 1.9744e-02 1.9620e-02	1.1937e-02	1.9175e-02
264 2.4425e+00 2.5127e+00 1.7363e-02 2.2809e-02	1.2173e-02	1.3747e-02
265 2.3800e+00 2.6115e+00 2.0442e-02 2.1310e-02	1.2109e-02	1.4840e-02
266 2.2785e+00 2.5458e+00 1.8672e-02 2.0411e-02	1.1977e-02	1.7837e-02
267 2.3249e+00 2.6415e+00 1.5432e-02 2.1902e-02	1.1821e-02	2.1390e-02
268 2.3643e+00 2.6719e+00 1.5949e-02 2.8710e-02	1.3834e-02	2.3121e-02
269 2.6704e+00 2.5744e+00 1.8839e-02 2.2620e-02	1.3032e-02	1.4271e-02
270 2.7665e+00 2.6183e+00 1.8696e-02 2.1424e-02	1.3423e-02	1.3153e-02
271 2.8867e+00 2.5466e+00 1.7074e-02 1.4217e-02	1.2651e-02	1.8838e-02
272 2.6163e+00 2.7595e+00 1.6455e-02 2.6270e-02	1.2772e-02	2.0845e-02
	1.3704e-02	3.0032e-02
273 2.3351e+00 2.5848e+00 2.0280e-02 1.8031e-02		1.8288e-02
273         2.3351e+00         2.5848e+00         2.0280e-02         1.8031e-02           274         2.3215e+00         2.8089e+00         1.8372e-02         2.4517e-02	1.3382e-02	1.02000-02
	1.3382e-02 1.3148e-02	2.6711e-02

N         All trons Method Thomasa         All mass Method Thomasa         All mass Method Thomasa         All mass Method Thomasa         All mass Thomasa         All mass Thomasa Thomasa         All mass Thomasa Thomasa Thomasa<			enie czasu rozw Precyzja float3		ıdu równań dla	macierzy A <sub>III</sub> Precyzja float6	
Metoda   Thomasa   Causs   C	-						$\mathbf{A_{III}}^{n \times n}$
277	n	Metoda	Metoda	Metoda	Metoda	Metoda	Metoda Gaussa
278         2.1605e+00         2.8184e+00         1.5288e-02         1.8731e-02         1.278e-02         1.914           279         2.9065e+00         2.2875e-00         2.288e-02         2.1378e-02         1.276e-02         2.251           281         2.3547e+00         2.8938e+00         2.4773e-02         2.1860e+02         1.4934e+02         1.875           282         2.4414e+00         2.8238e+00         7.7121e+02         1.446e+02         1.395e-02         2.351           284         2.3207e+00         2.2828e+00         7.7121e+02         2.388e-02         1.395e-02         2.388           285         2.634e+00         2.994e+00         1.886e+02         1.448e+02         1.395e-02         2.388           286         2.1785e+00         2.994e+00         1.586e+02         2.308e+02         1.537fe-02         1.467e-02         2.002           287         3.1543e+00         2.856e+00         1.665e+02         2.303e+02         1.451e-02         2.303           291         3.1273e+00         2.256e+02         2.256e+02         1.447e-02         2.26           292         3.0277e-02         2.941e-02         1.537e-02         1.476e-02         2.303           293         3.1353e-00 <td< td=""><td>277</td><td></td><td></td><td></td><td></td><td></td><td>2.0622e-02</td></td<>	277						2.0622e-02
279         2,9055e+00         2,7547e+00         2,3288e-02         2,4736e-02         1,2754e-02         2,235           280         1,3338e+00         2,2873ee-00         2,7470ee-02         2,1186e-02         1,2036e-02         1,001           282         2,4141ee-00         2,2823ee-00         2,7141ee-02         2,1866e-02         1,2078e-02         2,235           283         3,470ee-00         2,2222ee-00         1,2785e-02         2,2227ee-02         1,3958e-02         2,035           285         2,2834ee-00         2,2924ee-00         1,856ee-02         1,418e-02         1,3958e-02         2,035           285         2,2834ee-00         2,2945e-00         1,655ee-02         2,1284ee-02         1,5679e-02         1,5799e-02         1,4467e-02         2,303e-02         3,1359e-00         2,3634e-02         2,4467e-02         1,4467e-02         2,303e-02         1,4467e-02         2,303e-02         1,4467e-02         2,303e-02         1,4467e-02         2,303e-02         1,4467e-02         2,303e-02         1,4							1.9414e-02
282         2.5547e+00         2.8938e+00         2.7000e-02         2.1860e-02         1.4954e-02         1.2952e-02         2.533           282         2.4144e+00         2.8239e+00         1.7121e-02         2.235e-02         2.351           283         3.470e+00         2.9238e+00         1.7121e-02         2.2277e-02         1.3958e-02         2.388           284         2.3237e+00         2.9945e+00         1.5846e-02         1.1897a-02         1.3511e-02         2.002           287         3.1545e0         2.9946e+00         1.6652e-02         2.1284e-02         1.467e-02         2.03           289         3.1751e-00         2.586ee-00         1.5688e-02         2.363ee-02         1.447e-02         2.03           290         3.1382e0         3.030e-00         2.236ee-02         2.1430e-02         1.447e-02         2.20           291         3.2387e0         3.036ee-00         2.430ee-02         2.1478e-02         1.447e-02         2.20           293         3.3172e00         3.2385e+00         2.2306e-02         2.310e-02         1.4484e-02         1.358e-02         1.448e-02         1.448e-02         1.448e-02         1.448e-02         1.248e-02         1.248e-02         1.448e-02         1.448e-02         1.448e-02	_						2.2510e-02
222         2.414e+00         2.8239e+00         1.4203e-02         1.2469e-02         2.355e-02         1.2078e-02         2.238           233         3.470e+00         2.2228e+00         1.9778e-02         2.2227e-02         1.3958e-02         2.048           235         2.6834e+00         2.2945e+00         1.856e-02         1.4418e-02         1.351e-02         2.002           236         2.1735e+00         2.2941e+00         1.2856e-02         1.236e-02         1.5197e-02         1.5197e-02         1.236e-02         1.236e-02         1.247e-02         2.205           230         3.125e-00         3.1283e-00         2.356e-02         2.376e-02         1.441e-02         2.353           231         3.1285e-00         3.2485e-02         2.2175e-02         1.441e-02         2.353           231         3.3496e-01         3.2355e-00         2.2496e-02         2.255e-02         1.441e-02         1.556           233         3.4396e-01         3.3535e-00         2.2496e-02         2.255e-02         1.441e-02         1.556           233         3.4396e-03         3.3535e-00         2.2376e-02         2.356e-02         1.440e-02         1.72           234         4.3217e-03         3.3525e-00         2.2376e-02	280	3.1433e+00	2.8575e+00	2.4773e-02	2.1137e-02	1.2526e-02	1.9014e-02
283         3.4709+00         2.2828+00         2.7121e-02         2.2638e-02         1.2678e-02         2.2828e-00         1.9978e-02         2.2277e-02         1.9958e-02         2.285           2.68         2.1785e-00         2.9945e-00         1.8540e-02         1.4418e-02         1.3951e-02         2.292           286         2.1785e-00         2.9941e-00         2.287e-02         1.8095-02         1.5151e-02         2.292           287         3.1548e-00         2.8566e-00         1.6052e-02         2.1284e-02         1.5079e-02         1.717           289         3.1751e-00         3.0409e-00         2.346e-02         2.070-02         1.4311e-02         2.352           290         3.1682e-00         3.1283e-00         2.566e-02         2.3624e-02         1.4172e-02         2.232           291         3.207e-00         2.961t-00         1.5378e-02         2.2780e-02         1.4472e-02         2.352           301         3.3498e-00         3.055e+00         2.1378e-02         2.2597e-02         1.4581e-02         1.622           297         3.3399e-00         3.1264e-00         2.237e-02         2.259e-02         1.7558e-02         1.259           300         3.479e-00         3.298e-00         2.903e-02	281	2.3547e+00	2.8938e+00	2.7400e-02	2.1860e-02	1.4934e-02	1.8799e-02
284         2.3207+00         2.928e+00         1.9978e-02         2.2277e-02         1.3988e-02         2.388           285         2.6348e+00         2.9948e+00         1.8540e-02         1.4418e-02         1.3498e-02         2.2276           287         3.1543e+00         2.8566e+00         1.6052e-02         2.1284e-02         1.5079e-02         1.717           288         3.2258e+00         2.9448e+00         1.5689e-02         2.308e-02         1.4467e-02         2.03           290         3.153e-00         3.1838e+00         2.566e-02         2.304e-02         1.4311e-02         2.202           291         3.2300e-00         2.9978e+00         2.4485e-02         2.1758e-02         1.4172e-02         2.267           292         3.0207e-00         2.9611e-00         1.3787e-02         2.2780e-02         1.4161e-02         1.253           293         3.3438e-00         3.305e-00         2.2173e-02         2.259e-02         1.4311e-02         1.227           294         4.302e+00         3.235e-00         1.3975e-02         2.2930e-02         1.9311e-02         1.627           295         3.3172e-00         3.352e-00         1.3786e-02         2.2910e-02         1.4504e-02         1.728           296<	282	2.4414e+00	2.8239e+00	1.4203e-02	1.4469e-02	1.3052e-02	2.3517e-02
285         2.6834e+00         2.9945e+00         1.8540e+02         1.4418e+02         1.3498e+02         2.02           286         2.1785e+00         2.9941e+00         2.2827e-02         1.8093e+02         1.5511e+02         2.292           287         3.1549e+00         2.5866e+00         1.6562e+02         2.2484e-02         1.5797e-02         1.4467e-02         2.238           289         3.1751e+00         3.0403e+00         2.3486e-02         2.0770e-02         1.4311e-02         2.332           290         3.1682e+00         2.9973e+00         2.4484e-02         2.1735e-02         1.447e-02         2.236           293         3.4398e+00         3.285e+00         2.3656e-02         2.2156e-02         1.4161e-02         1.557           294         4.302e+00         3.2385e+00         2.365e-02         2.515e-02         1.4160e-02         1.227           295         3.3172e+00         3.2385e+00         2.3085e-02         2.2910e-02         1.4500e-02         1.222           296         3.3395e+00         3.1941e+00         2.2370e-02         2.1500e-02         1.7556         1.752           297         3.3389e+00         3.195e+00         1.9403e-02         2.2210e-02         1.4564e-02         1.752 <td>283</td> <td>3.4709e+00</td> <td>2.8289e+00</td> <td>2.7121e-02</td> <td>2.2638e-02</td> <td>1.2678e-02</td> <td>2.0482e-02</td>	283	3.4709e+00	2.8289e+00	2.7121e-02	2.2638e-02	1.2678e-02	2.0482e-02
286         2.1785e+00         2.9941e+00         2.287e-02         1.8093e-02         1.3511e-02         2.295           287         3.1543e+00         2.8566e+00         1.16692e-02         2.1284e-02         1.19079e-02         1.712           288         3.2255e+00         2.944e+00         1.5689e-02         2.2696e-02         1.4311e-02         2.352           290         3.1682e+00         3.1283e+00         2.5566e-02         2.3624e-02         1.4394e-02         2.302           291         3.2807e+00         2.997se+00         2.4845e-02         2.1755e-02         1.4172e-02         2.226           292         3.0207e+00         2.991te+00         1.5376e-02         2.2780e-02         1.4161e-02         1.555           293         3.4388e+00         3.005se+00         2.4307e-02         2.5165e-02         1.4283e-02         1.812           294         4.3029e+00         3.2385e+00         2.173e-02         2.3900e-02         1.9311e-01         1.627           295         3.3127e+00         3.2832e+00         2.2182e-02         2.2570e-02         1.758e-02         1.758e-02         1.728           299         3.4217e+00         3.2235e+00         2.9385e-02         2.2559e-02         1.7558e-02         1.758	284	2.3207e+00	2.9228e+00	1.9978e-02	2.2277e-02	1.3958e-02	2.3886e-02
287         3.1543e+00         2.856e+00         1.6052e+02         2.1284e+02         1.5079e+02         1.717           288         3.2255e+00         2.9449e+00         1.5689e+02         2.3968e+02         1.4467e+02         2.035           289         3.1751e+00         3.0403e+00         2.3486e+02         2.070e+02         1.4311e+02         2.230           291         3.2807e+00         2.9911e+00         1.578e+02         2.1759e+02         1.447e+02         2.267           292         3.0207e+00         2.9611e+00         1.578e+02         2.2760e+02         1.4161e+02         1.223           294         4.3029e+00         3.285e+00         2.2366e+02         2.5165e+02         1.4381e+02         1.94           295         3.3372e+00         3.1859e+00         1.8371e+02         2.2903e+02         1.9311e+02         1.62           296         3.3395e+00         3.1859e+00         1.8371e+02         2.2903e+02         1.9311e+02         1.62           297         3.3395e+00         3.1536e+00         2.2376e+02         2.2596e+02         1.7556e+02         1.72           298         3.4017e+00         3.299e+00         1.9439e+02         2.2210e+02         1.4564e+02         1.73           350 </td <td>285</td> <td>2.6834e+00</td> <td>2.9945e+00</td> <td>1.8540e-02</td> <td>1.4418e-02</td> <td>1.3498e-02</td> <td>2.0926e-02</td>	285	2.6834e+00	2.9945e+00	1.8540e-02	1.4418e-02	1.3498e-02	2.0926e-02
288         3.2255+00         2.9449+00         1.5689+02         2.3968+02         1.4467+02         2.203           289         3.1751+00         3.0403+00         2.3486-02         2.0770+02         1.4311+02         2.352           290         3.1682+00         3.2586+02         2.0770+02         1.4311+02         2.322           291         3.2870+00         2.9911+00         1.5378+02         2.2736-02         1.4472+02         2.262           293         3.4398+00         3.0605+00         2.3656-02         2.5159-02         1.4128-02         1.931           294         4.3029+00         3.2385+00         2.3666-02         2.5970-02         1.4600-02         1.227           295         3.3172+00         3.3558+00         2.1738-02         2.3902-02         1.7586-02         1.722           296         3.3395+00         3.1559+00         1.8371-02         2.23702-02         1.4600-02         1.722           297         3.3499+00         3.1916+00         2.28370-02         2.2590-02         1.7586-02         1.752           300         3.4799+00         3.1911+00         2.0876-02         2.2095-02         3.5666-02         1.5564-02         1.7546-02         1.752           310	286	2.1785e+00	2.9941e+00	2.2827e-02	1.8093e-02	1.3511e-02	2.2990e-02
289         3.1751e+00         3.0403e+00         2.3486e+02         2.0770e+02         1.4311e+02         2.252           290         3.1682e+00         3.1283e+00         2.2566e+02         2.3624e+02         1.4494e+02         2.202           291         3.2807e+00         2.9978e+00         2.4845e+02         2.1475e+02         1.4472e+02         2.202           292         3.0207e+00         2.991e+00         1.5578e+02         2.2780e+02         1.4161e+02         1.552           293         3.4398e+00         3.3665e+00         2.23665e+02         2.5597e+02         1.4381e+02         1.931           295         3.3172e+00         3.3558e+00         2.1738e+02         2.3903e+02         1.9311e+02         1.602           296         3.3399e+00         3.1564e+00         2.2237e+02         2.2559e+02         1.7568e+02         1.722           298         3.4217e+00         3.2998e+00         1.9405e+02         2.2010e+02         1.4564e+02         1.728           300         3.4799e+00         3.191e+00         2.2837e+02         2.2910e+02         1.4564e+02         1.758           452         7.5408e+00         3.2553e+02         2.2910e+02         1.4564e+02         1.758           452         7							1.7175e-02
290   3.1682e+00   3.1283e+00   2.5866e+02   2.3624e+02   1.4304e+02   2.3029							2.0308e-02
291   3.2807e+00   2.9973e+00   2.4845e-02   2.1753e-02   1.4472e-02   2.2662   2.293   3.0207e+00   2.9611e+00   1.5378e-02   2.2780e-02   1.4161e-02   1.5578   2.294   4.3029e+00   3.2385e+00   2.3665e-02   2.5597e-02   1.3812e-02   1.4162   2.292   2.293   3.3498e+00   3.355se+00   2.3665e-02   2.5997e-02   1.3812e-02   1.4028   2.292   2.293							2.3524e-02
292   3.0207e+00   2.9611e+00   1.5378e-02   2.2780e-02   1.4161e-02   1.555   293   3.4398e+00   3.0605e+00   2.4307e-02   2.5165e-02   1.4283e-02   1.941   294   4.3029e+00   3.2385e+00   2.1738e-02   2.5597e-02   1.3812e-02   1.942   295   3.3172e+00   3.355se+00   2.1738e-02   2.3905e-02   1.3911e-02   1.627   296   3.3395e+00   3.1859e+00   2.2337e-02   2.2559e-02   1.4600e-02   2.122   297   3.3407e+00   3.2832e+00   2.23085e-02   2.2910e-02   1.4504e-02   1.732   298   3.4017e+00   3.2988e+00   1.9403e-02   2.2210e-02   1.4504e-02   1.732   299   3.4217e+00   3.2998e+00   1.9403e-02   2.2210e-02   1.4504e-02   1.732   300   3.4799e+00   3.1911e+00   2.0837e-02   1.6976e-02   1.4746e-02   1.766   301   3.4799e+00   5.6246e+00   3.2553e-02   2.5095e-02   3.5666e-02   3.666494   452   7.5408e+00   5.7774e+00   2.5915e-02   2.6095e-02   3.5666e-02   3.666494   453   6.8435e+00   5.7774e+00   2.5915e-02   2.9886e-02   3.1617e-02   4.192444   454   3.4324e+00   5.7774e+00   3.2932e-02   2.9886e-02   3.1617e-02   4.193444   455   8.2274e+00   5.7774e+00   3.2912e-02   2.9882e-02   3.3037e-02   3.5666e-03   3.666460   3.2353e-03   3.866e-02   3.666460   3.3235e-03   3.866e-02   3.666460   3.3236e-03   3.5766e-03   3.9336e-03   3.3436e-03   3.5717e-00   3.866e-02   3.5970e-02   3.3833e-02   3.666460   3.3236e-00   5.8717e-00   3.866e-02   3.5970e-02   3.3833e-02   3.666460   3.3236e-00   5.8717e-00   4.1103e-02   3.5970e-02   3.3838e-03   3.646e-03   4.1662e-03   3.3726e-03   3.646e-03   4.1662e-03   3.3726e-03   3.646e-03   4.664640   3.5396e-00   5.8747e+00   4.1036e-02   3.1134e-02   3.8431e-02   3.646640   3.5936e-00   5.8746e-00   3.0141e-02   2.9006e-02   3.881e-02   3.666660   3.5940e-00   3.2756e-02   3.3726e-02   3.3831e-02   3.6666e-03   3.6666e-00   3.7940e-02   3.3796e-02   3.3800e-02   3.860e-02   3.6666e-03   3.6666e-00   3.7940e-02   3.4940e-02   3.820e-02   3.6666e-03   3.6666e-00   3.7940e-02   3.4940e-02   3.820e-02   3.6666e-03   3.6966e-00   3.7940e-02   3.4940e-02   3.6960e-02   3.6666e-03							2.3026e-02
293         3.4398e+00         3.0605e+00         2.4307e+02         2.5165e+02         1.4283e+02         1.8112e+02         1.8112e+02         1.944         4.3029e+00         3.2385e+00         2.2365e+02         2.5597e+02         1.8312e+02         1.944           295         3.3172e+00         3.3555e+00         2.1738e+02         2.3903e+02         1.4600e+02         2.122           297         3.3899e+00         3.1264e+00         2.2237e+02         2.2559e+02         1.4564e+02         1.732           299         3.4217e+00         3.2832e+00         2.3085e+02         2.2910e+02         1.4564e+02         1.755           300         3.4799e+00         3.1911e+00         2.0837e+02         1.6976e+02         1.4746e+02         1.766           452         7.540e+00         5.6246e+00         3.2553e+02         4.1925e+02         3.566e+02         3.568           452         7.540e+00         5.6774e+00         2.5915e+02         2.6095e+02         3.566e+02         3.566           453         6.8435e+00         5.7792e+00         4.2332e+02         2.9886e+02         3.161e+02         4.1932           455         8.2274e+00         5.7171e+00         3.0866e+02         4.1662e+02 3.361e+02         3.656							2.2676e-02
294         4,3029e+00         3,2385e+00         2,3665e+02         2,5597e+02         1,3812e+02         1,941           295         3,3172e+00         3,3553e+00         2,1738e+02         2,3905e+02         1,9311e+02         1,627           296         3,3355e+00         3,1859e+00         2,2237e+02         2,2559e+02         1,7558e+02         1,722           298         3,4017e+00         3,298e+00         1,9408e+02         2,2210e+02         1,4504e+02         1,732           300         3,4799e+00         3,1911e+00         2,0837e+02         1,6976e+02         1,4746e+02         1,763           451         6,7241e+00         5,6246e+00         3,2553e+02         2,1995e+02         2,3556e+02         3,576           452         7,5408e+00         5,7774e+00         2,5915e+02         2,6095e+02         3,566e+02         3,666e+02         3,666e+02         3,666e+02         3,616e+02         3,716e+02         3,716e+02 <t< td=""><td>_</td><td></td><td></td><td></td><td></td><td></td><td>1.5591e-02 1.8121e-02</td></t<>	_						1.5591e-02 1.8121e-02
295   3.3172e+00   3.3553e+00   2.1738e+02   2.3903e+02   1.9311e+02   1.627   296   3.3395e+00   3.1859e+00   1.8371e+02   2.2370e+02   1.4600e+02   1.726   297   3.3899e+00   3.1264e+00   2.2237e+02   2.2559e+02   1.7558e+02   1.726   298   3.4017e+00   3.2832e+00   1.9403e+02   2.2210e+02   1.3556e+02   1.732   299   3.4217e+00   3.2998e+00   1.9403e+02   2.2210e+02   1.3565e+02   1.756   300   3.4799e+00   3.1911e+00   2.0837e+02   1.6976e+02   1.4746e+02   1.766   300   3.4799e+00   5.6246e+00   3.2553e+02   4.1925e+02   2.8052e+02   3.5766e+02   3.6666e+02   3.6666e+00   5.7774e+00   2.5915e+02   2.6095e+02   3.5666e+02   3.6666e+03   3.933e+02   2.9886e+02   3.3416e+02   4.1662e+03   3.416e+02   4.1662e+03   3.416e+02   4.1662e+03   3.416e+02   4.1662e+03   3.416e+03   3.416e+							1.9406e-02
296   3.3395e+00   3.1859e+00   1.8371e+02   2.3702e+02   1.4600e+02   2.122	_						1.6279e-02
297   3.3899+00   3.1264e+00   2.2237e-02   2.2559e-02   1.7558e-02   1.722   298   3.4017e+00   3.2832e+00   2.3085e-02   2.2910e-02   1.4504e-02   1.732   300   3.4799e+00   3.1911e+00   2.0837e-02   1.6976e-02   1.4746e-02   1.768   301   3.4799e+00   3.1911e+00   2.0837e-02   1.6976e-02   1.4746e-02   1.768   302   3.4799e+00   3.1911e+00   2.0837e-02   1.6976e-02   1.4746e-02   1.768   303   3.4799e+00   5.6246e+00   3.2553e-02   4.1925e-02   2.8052e-02   3.5666e-02   3.668   452   5.6246e+00   5.7774e+00   2.5915e-02   2.6095e-02   3.5666e-02   3.668   453   6.8435e+00   5.6900e+00   3.9033e-02   4.2732e-02   3.7162e-02   3.7754e-90   4.2332e-02   2.9886e-02   3.1617e-02   3.7754e-90   4.2332e-02   2.9886e-02   3.1617e-02   3.1754e-90   4.2332e-02   2.9482e-02   3.0307e-02   3.6584e-90   5.7795e-00   3.9127e-02   2.9482e-02   3.0307e-02   3.6584e-90   5.8717e+00   3.8966e-02   3.6590e-02   3.4614e-02   4.1662e-03   3.6590e-00   5.8717e+00   4.1103e-02   3.5970e-02   4.5833e-02   3.6546e-03   4.1662e-03   3.5970e-02   4.5833e-03   3.6564e-03   3.6105e-02   3.134e-02   4.1574e-02   3.6546e-03   3.6165e-03   3.134e-03   4.1574e-03   3.6546e-03   3.6464e-03   3.6664e-03   3.6664	_						2.1226e-02
298   3.4017e+00   3.2832e+00   2.3085e-02   2.2910e-02   1.4504e-02   1.752   299   3.4217e+00   3.2998e+00   1.9403e-02   2.2210e-02   1.3563e-02   1.956   300   3.4799e+00   3.1911e+00   2.0837e-02   1.6976e-02   1.4746e-02   1.762   300   3.4799e+00   3.1911e+00   2.0837e-02   1.6976e-02   1.4746e-02   1.763   301   3.4799e+00   3.1911e+00   3.2553e-02   4.1925e-02   2.8052e-02   3.576   452   7.5408e+00   5.7774e+00   2.5915e-02   2.6095e-02   3.5666e-02   3.666   453   6.8435e+00   5.6900e+00   3.9033e-02   4.2732e-02   3.7162e-02   3.773   454   9.9636e+00   5.7771e+00   4.2332e-02   2.9886e-02   3.1617e-02   4.193   455   8.2274e+00   5.771e+00   3.0866e-02   4.1662e-02   3.2416e-02   3.174   456   8.3132e+00   5.7868e+00   3.9127e-02   2.9482e-02   3.0307e-02   3.655   457   8.0466e+00   5.871re+00   2.8914e-02   3.8621e-02   3.4614e-02   4.162   458   8.2369e+00   5.8517e+00   4.1103e-02   3.5970e-02   4.5833e-02   3.656   469   8.3236e+00   5.8374e+00   3.0141e-02   3.2845e-02   3.3725e-02   3.664   460   8.3236e+00   5.8374e+00   4.3003e-02   2.8245e-02   3.3725e-02   3.664   461   8.2361e+00   5.9539e+00   2.7758e-02   3.1149e-02   3.2881e-02   3.776   464   8.7539e+00   5.9918e+00   2.8545e-02   4.0940e-02   3.8007e-02   3.664   465   8.0214e+00   6.1358e+00   3.7940e-02   4.094e-02   3.8007e-02   3.664   466   8.0651e+00   6.1553e+00   3.7940e-02   4.1304e-02   3.189e-02   3.644   467   8.6007e+00   6.2106e+00   2.6759e-02   4.0784e-02   3.1189e-02   3.644   468   8.7453e+00   6.098e+00   3.8956e-02   4.478e-02   3.1189e-02   3.764   469   8.182e+00   6.098e+00   3.8956e-02   4.478e-02   3.1189e-02   3.764   470   8.2128e+00   6.0565e+00   3.5851e-02   4.174e-02   3.1189e-02   3.644   471   7.8518e+00   6.0565e+00   3.585e-02   4.0784e-02   3.1189e-02   3.644   472   7.9004e+00   6.2621e+00   5.8520e-02   4.1648e-02   3.2162e-02   3.694   473   8.0561e+00   6.2569e+00   4.3636e-02   4.1648e-02   3.2368e-02   3.764   474   8.0591e+00   6.6665e+00   3.277e-02   3.414e-02   3.136e-02   3.764   483							1.7260e-02
299   3.4217e+00   3.2998e+00   1.9403e-02   2.2210e-02   1.3563e-02   1.956	298						1.7324e-02
Section	299						1.9568e-02
452         7.5408e+00         5.7774e+00         2.5915e-02         2.6095e-02         3.5666e-02         3.664           453         6.8435e+00         5.6900e+00         3.9033e-02         4.2732e-02         3.7162e-02         3.7754e-02         3.7754e-00         3.7754e-00         4.2732e-02         2.9886e-02         3.1617e-02         4.1954           455         8.2274e+00         5.771re+00         3.0866e-02         4.1662e-02         3.2416e-02         3.175466e-01         3.175466         8.3123e-00         5.7968e+00         3.9127e-02         2.9482e-02         3.0307e-02         3.6554         4.1662e-00         3.4614e-02         4.1662e-02         3.4614e-02         4.1662e-02         3.4614e-02         4.1662e-02         3.4614e-02         4.1662e-02         3.5970e-02         4.5833e-02         3.6564         4.5769         4.1574e-02         3.6564         4.5769         4.1574e-02         3.2614e-02         3.3614e-02         3.1574e-02         3.2164e-02         3.2245e-02         3.3725e-02         3.6664         4.5833e-02         3.2841e-02         3.7774e-02         3.2841e-02         3.2841e-02         3.7774e-02         3.2841e-02         3.2841e-02         3.7774e-02         3.2841e-02         3.375e-02         3.1149e-02         3.5431e-02         3.7774e-02         3.2841e-02	300	3.4799e+00	3.1911e+00	2.0837e-02	1.6976e-02	1.4746e-02	1.7688e-02
452         7.5408e+00         5.7774e+00         2.5915e-02         2.6095e-02         3.5666e-02         3.664           453         6.8435e+00         5.6900e+00         3.9033e-02         4.2732e-02         3.7162e-02         3.7754e-02         3.7754e-00         3.7754e-00         4.2732e-02         2.9886e-02         3.1617e-02         4.1954           455         8.2274e+00         5.771re+00         3.0866e-02         4.1662e-02         3.2416e-02         3.175466e-01         3.175466         8.3123e-00         5.7968e+00         3.9127e-02         2.9482e-02         3.0307e-02         3.6554         4.1662e-00         3.4614e-02         4.1662e-02         3.4614e-02         4.1662e-02         3.4614e-02         4.1662e-02         3.4614e-02         4.1662e-02         3.5970e-02         4.5833e-02         3.6564         4.5769         4.1574e-02         3.6564         4.5769         4.1574e-02         3.2614e-02         3.3614e-02         3.1574e-02         3.2164e-02         3.2245e-02         3.3725e-02         3.6664         4.5833e-02         3.2841e-02         3.7774e-02         3.2841e-02         3.2841e-02         3.7774e-02         3.2841e-02         3.2841e-02         3.7774e-02         3.2841e-02         3.375e-02         3.1149e-02         3.5431e-02         3.7774e-02         3.2841e-02							
453         6.8435e+00         5.6900e+00         3.9033e-02         4.2732e-02         3.7162e-02         3.7764           454         9.9636e+00         5.7792e+00         4.2332e-02         2.9886e-02         3.1617e-02         4.193           455         8.2274e+00         5.7171e+00         3.0866e-02         3.626e-02         3.4614e-02         3.167           456         8.3123e+00         5.7968e+00         3.9127e-02         2.9482e-02         3.0307e-02         3.651           457         8.0466e+00         5.8717e+00         2.8914e-02         3.570e-02         4.1632e-02         3.4614e-02         4.16           458         8.2369e+00         5.817e+00         4.1103e-02         3.570e-02         4.5833e-02         3.65           459         7.7932e+00         5.8473e+00         3.6105e-02         3.1134e-02         4.1574e-02         3.213           460         8.320se+00         5.9240e+00         3.0141e-02         2.9006e-02         3.8046e-02         4.664           462         8.2567e+00         5.9539e+00         2.2755e-02         3.1149e-02         3.541e-02         3.134           463         8.3935e+00         5.9539e+00         2.2854e-02         3.149e-02         3.807e-02         2.955	451	6.7241e+00	5.6246e+00	3.2553e-02	4.1925e-02	2.8052e-02	3.5762e-02
454         9,9636e+00         5.7792e+00         4.2332e-02         2.9886e-02         3.1617e-02         4.193           455         8.2274e+00         5.717le+00         3.0866e-02         4.1662e-02         3.2416e-02         3.178           456         8.3123e+00         5.7968e+00         2.8914e-02         3.8621e-02         3.4614e-02         4.165           457         8.0466e+00         5.8717e+00         2.8914e-02         3.8621e-02         3.4614e-02         4.153           458         8.2369e+00         5.8517e+00         4.103e-02         3.570e-02         4.583e-02         3.65           459         7.7932e+00         5.8478e+00         3.6105e-02         3.1134e-02         4.1574e-02         3.213           460         8.3208e+00         5.8374e+00         4.3003e-02         2.2845e-02         3.3725e-02         3.661           461         8.2361e+00         5.9539e+00         2.9196e-02         3.3279e-02         3.2881e-02         3.775e-02         3.134e-02         3.5431e-02         3.734e-02         4.684         8.733e+00         5.9918e+00         2.2854e-02         3.140e-02         3.800e-02         3.952e-02         3.664         8.607e-02         3.140e-02         3.561e-02         3.664         8.607e-02	_						3.6680e-02
455         8.2274e+00         5.7171e+00         3.0866e-02         4.1662e-02         3.2416e-02         3.178           456         8.3123e+00         5.7968e+00         3.9127e-02         2.9482e-02         3.0307e-02         3.655           457         8.0466e+00         5.8717e+00         2.8914e-02         3.621e-02         3.4614e-02         4.163           458         8.2369e+00         5.8517e+00         4.1103e-02         3.5970e-02         4.583ae-02         3.621           460         8.3208e+00         5.8473e+00         4.3003e-02         2.8245e-02         3.3725e-02         3.661           461         8.2361e+00         5.9240e+00         3.0141e-02         2.906e-02         3.8046e-02         4.684           462         8.2567e+00         6.0586e+00         2.9196e-02         3.3279e-02         3.881e-02         3.773           463         8.3935e+00         5.9539e+00         2.7758e-02         3.1149e-02         3.5431e-02         3.104           464         8.7539e+00         6.1358e+00         3.7940e-02         4.304e-02         3.950e-02         3.664           467         8.6007e+00         6.2106e+00         2.6759e-02         4.3016e-02         3.820e-02         3.464 <td< td=""><td>453</td><td>6.8435e+00</td><td>5.6900e+00</td><td>3.9033e-02</td><td>4.2732e-02</td><td>3.7162e-02</td><td>3.7754e-02</td></td<>	453	6.8435e+00	5.6900e+00	3.9033e-02	4.2732e-02	3.7162e-02	3.7754e-02
456         8.3123e+00         5.7968e+00         3.9127e-02         2.9482e-02         3.0307e-02         3.655           457         8.0466e+00         5.8717e+00         2.8914e-02         3.8621e-02         3.4614e-02         4.162           458         8.2369e+00         5.817e+00         4.1103e-02         3.5970e-02         4.583a-02         3.656           459         7.7932e+00         5.847ae+00         4.3003e-02         2.2445e-02         3.3725e-02         3.661           460         8.3208e+00         5.8374e+00         4.3003e-02         2.2445e-02         3.3046e-02         3.664           461         8.2567e+00         6.0586e+00         2.9196e-02         3.3279e-02         3.2881e-02         3.77           463         8.3935e+00         5.9539e+00         2.7758e-02         3.1149e-02         3.431e-02         3.13           464         8.7539e+00         5.9918e+00         2.8545e-02         4.1940e-02         3.8007e-02         2.954           465         8.0214e+00         6.1553e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.664           467         8.6007e+00         6.216e+00         2.6759e-02         4.0784e-02         3.1907e-02         3.42	454	9.9636e+00	5.7792e+00	4.2332e-02	2.9886e-02	3.1617e-02	4.1939e-02
457         8.0466e+00         5.8717e+00         2.8914e-02         3.8621e-02         3.4614e-02         4.162           458         8.2369e+00         5.8517e+00         4.1103e-02         3.5970e-02         4.5833e-02         3.656           459         7.7932e+00         5.8473e+00         3.6105e-02         3.1134e-02         4.1574e-02         3.213           460         8.3208e+00         5.8374e+00         4.3003e-02         2.8245e-02         3.375e-02         3.666           461         8.2361e+00         5.9240e+00         3.0114e-02         2.9006e-02         3.864e-02         4.684           462         8.2567e+00         6.0586e+00         2.9196e-02         3.3279e-02         3.2881e-02         3.77           463         8.3935e+00         5.9539e+00         2.2758e-02         4.0940e-02         3.8007e-02         2.952           465         8.0214e+00         6.1358e+00         3.794e-02         4.1304e-02         3.952e-02         3.067           466         8.6007e+00         6.1553e+00         3.794e-02         2.9842e-02         2.8610e-02         3.544           468         8.7453e+00         6.1191e+00         3.955e-02         4.0784e-02         3.1907e-02         3.24           4							3.1788e-02
458         8.2369e+00         5.8517e+00         4.1103e-02         3.5970e-02         4.5833e-02         3.655           459         7.7932e+00         5.8473e+00         3.6105e-02         3.1134e-02         4.1574e-02         3.213           460         8.3208e+00         5.8374e+00         4.3003e-02         2.8245e-02         3.3725e-02         3.661           461         8.2361e+00         5.9240e+00         3.0141e-02         2.9006e-02         3.8046e-02         4.684           462         8.2567e+00         6.0586e+00         2.9196e-02         3.3149e-02         3.5431e-02         3.77           463         8.3935e+00         5.9539e+00         2.2758e-02         3.1149e-02         3.8007e-02         2.953           465         8.0214e+00         6.1358e+00         3.7940e-02         4.1304e-02         3.9520e-02         3.664           466         8.051e+00         6.1553e+00         3.7940e-02         4.916e-02         3.8280e-02         3.544           467         8.6007e+00         6.191e+00         3.955e-02         4.0784e-02         3.820e-02         3.424           468         8.7453e+00         6.1191e+00         3.955e-02         4.0784e-02         3.1189e-02         3.541							3.6551e-02
459         7.7932e+00         5.8473e+00         3.6105e-02         3.1134e-02         4.1574e-02         3.213           460         8.3208e+00         5.8374e+00         4.3003e-02         2.8245e-02         3.3725e-02         3.661           461         8.2361e+00         5.9240e+00         3.0141e-02         2.9006e-02         3.2881e-02         4.684           462         8.2567e+00         6.0586e+00         2.9196e-02         3.3279e-02         3.2881e-02         3.774           463         8.3935e+00         5.9939e+00         2.2758e-02         4.0940e-02         3.807e-02         2.955           465         8.0339e+00         5.9938e+00         2.2757e-02         4.0940e-02         3.807e-02         2.955           466         8.0651e+00         6.1358e+00         3.7940e-02         4.904e-02         3.820e-02         3.664           467         8.6007e+00         6.2106e+00         2.6759e-02         4.301e-02         3.828e-02         3.541           468         8.7453e+00         6.1191e+00         3.9555e-02         4.0784e-02         3.1907e-02         3.541           470         8.2128e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1139e-02         3.541 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td>4.1624e-02</td></t<>							4.1624e-02
460         8.3208e+00         5.8374e+00         4.3003e-02         2.8245e-02         3.3725e-02         3.661           461         8.2361e+00         5.9240e+00         3.0141e-02         2.9006e-02         3.8046e-02         4.684           462         8.2567e+00         6.0586e+00         2.9196e-02         3.3279e-02         3.2881e-02         3.7746e-02         3.1149e-02         3.5431e-02         3.13           463         8.3935e+00         5.9918e+00         2.8545e-02         4.1304e-02         3.8007e-02         2.955           466         8.7539e+00         6.1558e+00         3.795e-02         4.1304e-02         3.9520e-02         3.067           466         8.0651e+00         6.1553e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.664           467         8.6007e+00         6.1553e+00         3.7940e-02         2.9842e-02         3.820e-02         3.544           468         8.6182e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.544           469         8.6182e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.541           471         7.8518e+00         6.295e+00         3.6747e-02         4.8098e-02<							3.6567e-02
461         8.2361e+00         5.9240e+00         3.0141e-02         2.9006e-02         3.8046e-02         4.684           462         8.2567e+00         6.0586e+00         2.9196e-02         3.2379e-02         3.2881e-02         3.770           463         8.3935e+00         5.9539e+00         2.7758e-02         3.1149e-02         3.5431e-02         3.174           464         8.7539e+00         5.9918e+00         2.8545e-02         4.1904e-02         3.8007e-02         2.954           465         8.0214e+00         6.1558e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.064           466         8.0651e+00         6.1553e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.664           467         8.6007e+00         6.216ee+00         2.6759e-02         4.3016e-02         3.1907e-02         3.42           468         8.7453e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.24           469         8.6182e+00         6.0565e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.861           479         8.212se+00         6.0998e+00         2.8045e-02         4.0152e-02         3.5133e-02         3.765							3.2137e-02 3.6617e-02
462         8.2567e+00         6.0586e+00         2.9196e-02         3.3279e-02         3.2881e-02         3.77           463         8.3935e+00         5.9539e+00         2.7758e-02         3.1149e-02         3.5431e-02         3.13           464         8.7539e+00         5.9918e+00         2.8545e-02         4.0940e-02         3.8007e-02         2.955           465         8.0214e+00         6.1358e+00         3.7954e-02         4.1304e-02         3.9520e-02         3.664           466         8.0651e+00         6.1553e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.664           467         8.6007e+00         6.2106e+00         2.6759e-02         4.3016e-02         3.2820e-02         3.544           468         8.7453e+00         6.1191e+00         3.9555e-02         4.0784e-02         3.1907e-02         3.42           469         8.6182e+00         6.0565e+00         3.5861e-02         4.4783e-02         3.1897e-02         3.51           470         8.2128e+00         6.0998e+00         3.861e-02         4.4783e-02         3.2162e-02         3.864           472         7.9004e+00         6.2621e+00         5.8520e-02         4.1508e-02         3.5906e-02         3.674 <t< td=""><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	-						
463         8.3935e+00         5.9539e+00         2.7758e-02         3.1149e-02         3.5431e-02         3.134           464         8.7539e+00         5.9918e+00         2.8545e-02         4.0940e-02         3.8007e-02         2.955           465         8.0214e+00         6.1358e+00         3.7954e-02         4.1304e-02         3.9520e-02         3.067           466         8.0651e+00         6.1553e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.646           467         8.6007e+00         6.2106e+00         2.6759e-02         4.0784e-02         3.1907e-02         3.42           468         8.7453e+00         6.1191e+00         3.9555e-02         4.0784e-02         3.1907e-02         3.42           469         8.6182e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.54           470         8.2128e+00         6.0998e+00         2.8045e-02         4.4783e-02         2.6027e-02         3.79           471         7.8518e+00         6.2521e+00         5.8520e-02         4.152e-02         3.513e-02         3.76           472         7.9004e+00         6.2620e+00         4.3836e-02         4.1508e-02         3.6906e-02         3.67           4							4.6844e-02 3.7701e-02
464         8.7539e+00         5.9918e+00         2.8345e-02         4.0940e-02         3.8007e-02         2.955           465         8.0214e+00         6.1358e+00         3.7954e-02         4.1304e-02         3.9520e-02         3.067           466         8.0651e+00         6.1553e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.664           467         8.6007e+00         6.2106e+00         2.6759e-02         4.301e-02         3.8280e-02         3.544           468         8.7453e+00         6.0191e+00         3.9555e-02         4.0784e-02         3.1907e-02         3.42           469         8.6182e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.541           470         8.2128e+00         6.0998e+00         2.8045e-02         4.4783e-02         3.602e-02         3.764           471         7.8518e-00         6.2155e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.361           473         8.0561e+00         6.2020e+00         5.8320e-02         4.1508e-02         3.5455e-02         3.674           474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.67           <							3.1309e-02
465         8.0214e+00         6.1358e+00         3.7954e-02         4.1304e-02         3.9520e-02         3.067           466         8.0651e+00         6.1553e+00         3.7940e-02         2.9842e-02         2.8610e-02         3.664           467         8.6007e+00         6.2106e+00         2.6759e-02         4.0764e-02         3.1297e-02         3.544           468         8.7453e+00         6.0191e+00         3.9555e-02         4.0784e-02         3.1907e-02         3.44           468         8.6182e+00         6.0565e+00         3.5861e-02         4.0784e-02         3.1907e-02         3.54           470         8.2128e+00         6.0998e+00         2.8045e-02         4.4783e-02         2.6027e-02         3.791           471         7.8518e+00         6.2155e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.861           472         7.9004e+00         6.221e+00         5.8520e-02         4.1508e-02         3.6996e-02         3.765           473         8.0551e+00         6.2020e+00         4.3386e-02         4.1648e-02         3.5455e-02         3.674           474         8.0591e+00         6.3347e+00         3.2756e-02         4.1622e-02         3.7164e-02         3.524							2.9551e-02
467         8.6007e+00         6.2106e+00         2.6759e-02         4.3016e-02         3.8280e-02         3.545           468         8.7453e+00         6.1191e+00         3.9555e-02         4.0784e-02         3.1907e-02         3.420           469         8.6182e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.541           470         8.2128e+00         6.0998e+00         2.8045e-02         4.4783e-02         2.6027e-02         3.791           471         7.8518e+00         6.2155e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.766           472         7.904e+00         6.2021e+00         5.8520e-02         4.0152e-02         3.5133e-02         3.765           473         8.0561e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.674           475         8.0557e+00         6.3547e+00         3.2753e-02         4.1629e-02         3.7164e-02         3.547           476         8.2541e+00         6.1699e+00         5.1339e-02         4.5902e-02         3.7164e-02         3.562e-02         4.787           478         8.1203e+00         6.2318e+00         3.2772e-02         3.3607e-02         4.356e-02         3.662e-02<	465				4.1304e-02		3.0675e-02
468         8.7453e+00         6.1191e+00         3.9555e-02         4.0784e-02         3.1907e-02         3.420           469         8.6182e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.541           470         8.2128e+00         6.0998e+00         2.8045e-02         4.4783e-02         2.6027e-02         3.791           471         7.8518e+00         6.2155e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.816           472         7.9004e+00         6.2621e+00         5.8520e-02         4.1508e-02         3.5133e-02         3.676           473         8.0561e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.677           474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.677           475         8.0557e+00         6.3547e+00         3.2753e-02         4.1622e-02         4.1029e-02         3.815           476         8.2541e+00         6.1699e+00         3.5292e-02         5.3360e-02         3.0108e-02         2.624           478         8.1203e+00         6.6665e+00         3.2772e-02         3.600r-02         3.404e-02         3.662e-02         2.851	466	8.0651e+00	6.1553e+00	3.7940e-02	2.9842e-02	2.8610e-02	3.6641e-02
469         8.6182e+00         6.0565e+00         3.5861e-02         3.4172e-02         3.1189e-02         3.541           470         8.2128e+00         6.0998e+00         2.8045e-02         4.4783e-02         2.6027e-02         3.791           471         7.8518e+00         6.2155e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.861           472         7.9004e+00         6.2621e+00         5.8520e-02         4.0152e-02         3.5133e-02         3.764           473         8.0561e+00         6.2020e+00         3.3789e-02         4.1648e-02         3.5455e-02         3.676           474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.677           475         8.0557e+00         6.3547e+00         3.2753e-02         4.1622e-02         4.1029e-02         3.815           476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.665e+00         3.572e-02         3.360e-02         3.0108e-02         2.624           478         8.1233e+00         6.2318e+00         4.3727e-02         2.6414e-02         3.3662e-02         2.344	467	8.6007e+00	6.2106e+00	2.6759e-02	4.3016e-02	3.8280e-02	3.5496e-02
470         8.2128e+00         6.0998e+00         2.8045e-02         4.4783e-02         2.6027e-02         3.791           471         7.8518e+00         6.2155e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.861           472         7.9004e+00         6.2621e+00         5.8520e-02         4.11508e-02         3.1533e-02         3.764           473         8.0561e+00         6.2090e+00         3.3789e-02         4.1508e-02         3.6906e-02         3.764           474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.677           475         8.0557e+00         6.3547e+00         3.2753e-02         4.1622e-02         4.1029e-02         3.815           476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.665e+00         3.5292e-02         5.3360e-02         3.0108e-02         2.624           478         8.1269e+00         6.231e+00         4.372r-02         2.6414e-02         3.3662e-02         2.851           480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2335e-02         3.197	468	8.7453e+00	6.1191e+00	3.9555e-02	4.0784e-02	3.1907e-02	3.4203e-02
471         7.8518e+00         6.2155e+00         3.6747e-02         4.8098e-02         3.2162e-02         3.861           472         7.9004e+00         6.2621e+00         5.8520e-02         4.0152e-02         3.5133e-02         3.765           473         8.0561e+00         6.2029e+00         3.3789e-02         4.1508e-02         3.5455e-02         3.674           474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.677           475         8.0557e+00         6.3347e+00         3.2753e-02         4.1622e-02         3.7164e-02         3.524           476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.665e+00         3.5292e-02         5.3360e-02         3.0108e-02         2.626           478         8.1203e+00         6.2318e+00         4.3727e-02         2.6414e-02         3.562e-02         2.851           479         8.2146e+00         6.3016e+00         3.2772e-02         3.4436e-02         4.3504e-02         3.19           480         8.1233e+00         6.4300e+00         3.6198e-02         3.44104e-02         4.0031e-02         6.655	469	8.6182e+00	6.0565e+00	3.5861e-02	3.4172e-02	3.1189e-02	3.5413e-02
472         7.9004e+00         6.2621e+00         5.8520e-02         4.0152e-02         3.5133e-02         3.766           473         8.0561e+00         6.2099e+00         3.3789e-02         4.1508e-02         3.6906e-02         3.766           474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.677           475         8.0557e+00         6.3547e+00         3.2753e-02         4.1622e-02         4.1029e-02         3.814           476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.6665e+00         3.5292e-02         5.3360e-02         3.108e-02         3.662e-02         2.851           478         8.1203e+00         6.2318e+00         4.3727e-02         2.6414e-02         3.3662e-02         2.851           479         8.2146e+00         6.3016e+00         3.2772e-02         3.9607e-02         4.3504e-02         3.044           480         8.1233e+00         6.7554e+00         3.7008e-02         3.4436e-02         3.2355e-02         3.19           481         8.3924e+00         6.5543e+00         4.9765e-02         3.4908e-02         4.0934e-02         4.651	470	8.2128e+00	6.0998e+00	2.8045e-02	4.4783e-02	2.6027e-02	3.7911e-02
473         8.0561e+00         6.2099e+00         3.3789e-02         4.1508e-02         3.6906e-02         3.764           474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.545e-02         3.677           475         8.0557e+00         6.3547e+00         3.2753e-02         4.1622e-02         4.1029e-02         3.819           476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.6665e+00         3.5292e-02         5.3360e-02         3.0108e-02         2.622           478         8.1203e+00         6.2318e+00         4.3727e-02         3.9607e-02         4.3504e-02         3.64           480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2335e-02         3.197           481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.655           482         8.3338e+00         6.5546e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.014           483         8.2196e+00         6.5546e+00         3.9407e-02         3.418e-02         3.635e-02         2.730           <	471	7.8518e+00	6.2155e+00	3.6747e-02	4.8098e-02	3.2162e-02	3.8617e-02
474         8.0591e+00         6.2020e+00         4.3836e-02         4.1648e-02         3.5455e-02         3.677           475         8.0557e+00         6.3547e+00         3.2753e-02         4.1622e-02         4.1029e-02         3.815           476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.6665e+00         3.5292e-02         5.3360e-02         3.0108e-02         2.624           478         8.1203e+00         6.6316e+00         4.3727e-02         2.6414e-02         3.3662e-02         2.851           479         8.2146e+00         6.3016e+00         3.2772e-02         3.9607e-02         4.3504e-02         3.4346e-02         3.2335e-02         3.197           481         8.392de+00         6.7554e+00         3.7008e-02         4.410e-02         4.0934e-02         6.652           482         8.3338e+00         6.5346e+00         4.0765e-02         3.498e-02         3.0540e-02         4.014           483         8.2196e+00         6.5546e+00         3.9407e-02         4.148e-02         3.6335e-02         2.734           484         8.2453e+00         6.5548e+00         3.9407e-02         3.418e-02         3.0540e-02<	472	7.9004e+00	6.2621e+00	5.8520e-02	4.0152e-02	3.5133e-02	3.7692e-02
475         8.0557e+00         6.3547e+00         3.2753e-02         4.1622e-02         4.1029e-02         3.815           476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.6665e+00         3.5292e-02         5.3360e-02         3.3108e-02         2.624           478         8.1203e+00         6.2318e+00         4.3727e-02         2.6414e-02         3.3662e-02         2.851           479         8.2146e+00         6.3016e+00         3.2772e-02         3.9607e-02         4.3504e-02         3.044           480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2335e-02         3.197           481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.652           482         8.3338e+00         6.5436e+00         2.8647e-02         4.4184e-02         3.635e-02         2.734           484         8.2453e+00         6.5548e+00         3.940re-02         3.4918e-02         3.0540e-02         3.638e-02           485         8.2806e+00         6.5928e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.6962e-02         2.79	_						3.7697e-02
476         8.2541e+00         6.1699e+00         5.1339e-02         4.6902e-02         3.7164e-02         3.524           477         8.0042e+00         6.6665e+00         3.5292e-02         5.3360e-02         3.0108e-02         2.626           478         8.1203e+00         6.2318e+00         4.3727e-02         2.6414e-02         3.3602e-02         2.8514           479         8.2146e+00         6.3016e+00         3.2772e-02         3.9607e-02         4.3504e-02         3.044           480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2335e-02         3.197           481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.655           482         8.3338e+00         6.5436e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.018           483         8.296e+00         6.5543e+00         2.8647e-02         4.418e-02         3.0540e-02         3.273           484         8.2453e+00         6.552e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.63           485         8.2806e+00         6.528e+00         3.0737e-02         3.4104e-02         3.8985e-02         2.794           <		0.05716.00				5.5155C 0E	3.6777e-02
477         8.0042e+00         6.6665e+00         3.5292e-02         5.3360e-02         3.0108e-02         2.624           478         8.1203e+00         6.2318e+00         4.3727e-02         2.6414e-02         3.3662e-02         2.851           479         8.2146e+00         6.3016e+00         3.2772e-02         3.9607e-02         4.3504e-02         3.044           480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2355e-02         3.19           481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.653           482         8.3338e+00         6.5543e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.618           483         8.2196e+00         6.5543e+00         2.8647e-02         3.4918e-02         3.0540e-02         2.73           484         8.2453e+00         6.5546e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.635e-02         2.794           485         8.2806e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.695e-02         2.794           486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.8985e-02         2.794	$\rightarrow$						3.8151e-02
478         8.1203e+00         6.2318e+00         4.3727e-02         2.6414e-02         3.3662e-02         2.851           479         8.2146e+00         6.3016e+00         3.2772e-02         3.9607e-02         4.3504e-02         3.044           480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2335e-02         3.197           481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.654           482         8.3338e+00         6.5543e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.018           483         8.2196e+00         6.5546e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.318           485         8.2806e+00         6.5628e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.635e-02         2.794           486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.6962e-02         2.794           487         8.3667e+00         6.5875e+00         3.7737e-02         3.4104e-02         3.1265e-02         4.09           488         8.2952e+00         6.6819e+00         3.1346e-02         4.575e-02         3.9178e-02         4.02	-						3.5246e-02
479         8.2146e+00         6.3016e+00         3.2772e-02         3.9607e-02         4.3504e-02         3.044           480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2335e-02         3.197           481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.655           482         8.3338e+00         6.5436e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.034           483         8.2196e+00         6.5546e+00         2.8647e-02         4.4184e-02         3.6335e-02         2.73           484         8.2453e+00         6.5546e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.633           485         8.2806e+00         6.6528e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.633           486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.6962e-02         2.794           487         8.3667e+00         6.5876e+00         3.7737e-02         3.4104e-02         3.8955e-02         2.93           488         8.2952e+00         6.6829e+00         4.4563e-02         4.6012e-02         3.1256e-02         4.094							2.6260e-02
480         8.1233e+00         6.4300e+00         3.6198e-02         3.4436e-02         3.2335e-02         3.197           481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.655           482         8.3338e+00         6.5436e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.018           483         8.2196e+00         6.5543e+00         2.8647e-02         4.4184e-02         3.6335e-02         2.73           484         8.2453e+00         6.5528e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.318           485         8.2806e+00         6.5628e+00         4.9608e-02         4.1448e-02         3.2945e-02         2.794           487         8.3667e+00         6.5878e+00         3.7737e-02         3.4104e-02         3.8985e-02         2.93           488         8.2952e+00         6.6829e+00         4.4563e-02         4.6012e-02         3.125e-02         4.012           489         8.4275e+00         6.6819e+00         3.134e-02         4.5317e-02         5.2590e-02         3.514           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.514           <	-						2.8513e-02
481         8.3924e+00         6.7554e+00         3.7008e-02         4.4104e-02         4.0031e-02         6.652           482         8.3338e+00         6.5436e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.018           483         8.2196e+00         6.5543e+00         2.8647e-02         3.4184e-02         3.6355e-02         2.73           484         8.2453e+00         6.5528e+00         4.9608e-02         3.4918e-02         3.0540e-02         3.318           485         8.2806e+00         6.5628e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.6962e-02         2.794           487         8.3667e+00         6.5875e+00         3.7737e-02         3.4104e-02         3.8985e-02         2.936           488         8.2952e+00         6.6829e+00         4.4563e-02         4.6012e-02         3.1265e-02         4.091           489         8.4275e+00         6.6819e+00         3.1346e-02         4.5317e-02         3.2178e-02         3.9178e-02           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5496e-02         4.830e-02         2.500           492         8.5399e+00         6.806e+00         4.0375e-02         3.6687e-02         4.9934e-02         3.259	_						3.0443e-02 3.1979e-02
482         8.3338e+00         6.5436e+00         4.0765e-02         3.2608e-02         4.0934e-02         4.018           483         8.2196e+00         6.5543e+00         2.8647e-02         4.4184e-02         3.6335e-02         2.730           484         8.2453e+00         6.5546e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.318           485         8.2806e+00         6.5628e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.692e-02         2.734           486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.692e-02         2.794           487         8.3667e+00         6.5875e+00         3.7737e-02         3.4104e-02         3.8985e-02         2.936           488         8.2952e+00         6.6829e+00         4.4563e-02         4.6758e-02         3.1265e-02         4.091           489         8.4275e+00         6.6819e+00         3.1346e-02         4.7578e-02         3.9178e-02         6.257           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.934e-02         4.934e-02<	_						6.6559e-02
483         8.2196e+00         6.5543e+00         2.8647e-02         4.4184e-02         3.6335e-02         2.730           484         8.2453e+00         6.5546e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.318           485         8.2806e+00         6.5628e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.6962e-02         2.794           486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.6962e-02         2.794           487         8.3667e+00         6.5875e+00         3.7737e-02         3.4104e-02         3.8985e-02         2.936           488         8.2952e+00         6.6819e+00         4.4563e-02         4.6758e-02         3.9178e-02         6.257           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.3830e-02         2.500           492         8.5399e+00         6.806e+00         4.7254e-02         3.6687e-02         4.9934e-02         4.084							4.0182e-02
484         8.2453e+00         6.5546e+00         3.9407e-02         3.4918e-02         3.0540e-02         3.318           485         8.2806e+00         6.5628e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.635           486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.6962e-02         2.794           487         8.3667e+00         6.5875e+00         3.7737e-02         3.4104e-02         3.895e-02         2.93           488         8.2952e+00         6.6829e+00         4.4563e-02         4.6012e-02         3.1265e-02         4.09           489         8.4275e-00         6.6819e+00         3.1346e-02         4.5778e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.3830e-02         2.500           492         8.5399e+00         6.806e+00         4.7254e-02         3.6687e-02         4.9934e-02         4.084	_						2.7303e-02
485         8.2806e+00         6.5628e+00         4.9608e-02         4.1448e-02         3.2945e-02         3.633           486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.6962e-02         2.794           487         8.3667e+00         6.5875e+00         3.7737e-02         3.4104e-02         3.8985e-02         2.936           488         8.2952e+00         6.6829e+00         4.4563e-02         4.6012e-02         3.1256e-02         4.094           489         8.4275e+00         6.6819e+00         3.1346e-02         4.7578e-02         3.9178e-02         6.257           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.830e-02         2.500           492         8.5399e+00         6.8006e+00         4.7254e-02         3.6687e-02         4.9934e-02         4.084	484	8.2453e+00					3.3180e-02
486         8.2648e+00         6.9142e+00         3.3020e-02         5.2439e-02         3.6962e-02         2.794           487         8.3667e+00         6.5875e+00         3.7737e-02         3.4104e-02         3.8985e-02         2.936           488         8.2952e+00         6.6829e+00         4.4563e-02         4.6012e-02         3.1256e-02         4.09           489         8.4275e+00         6.6819e+00         3.1346e-02         4.7578e-02         3.9178e-02         6.257           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.830e-02         2.500           492         8.5399e+00         6.8006e+00         4.7254e-02         3.6687e-02         4.9934e-02         4.084							3.6394e-02
488         8.2952e+00         6.6829e+00         4.4563e-02         4.6012e-02         3.1265e-02         4.091           489         8.4275e+00         6.6819e+00         3.1346e-02         4.7578e-02         3.9178e-02         6.257           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.3830e-02         2.500           492         8.5399e+00         6.8006e+00         4.7254e-02         3.6687e-02         4.9934e-02         4.084	486		6.9142e+00	3.3020e-02	5.2439e-02	3.6962e-02	2.7949e-02
489         8.4275e+00         6.6819e+00         3.1346e-02         4.7578e-02         3.9178e-02         6.257           490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.3830e-02         2.500           492         8.5399e+00         6.8006e+00         4.7254e-02         3.6687e-02         4.9934e-02         4.084	487	8.3667e+00	6.5875e+00	3.7737e-02	3.4104e-02	3.8985e-02	2.9365e-02
490         8.3854e+00         6.8781e+00         4.0208e-02         4.5317e-02         5.2590e-02         3.314           491         8.5588e+00         6.7378e+00         4.0375e-02         4.6496e-02         4.3830e-02         2.500           492         8.5399e+00         6.8006e+00         4.7254e-02         3.6687e-02         4.9934e-02         4.084	488	8.2952e+00	6.6829e+00	4.4563e-02	4.6012e-02	3.1265e-02	4.0916e-02
491     8.5588e+00     6.7378e+00     4.0375e-02     4.6496e-02     4.3830e-02     2.500       492     8.5399e+00     6.8006e+00     4.7254e-02     3.6687e-02     4.9934e-02     4.084	489	8.4275e+00	6.6819e+00	3.1346e-02	4.7578e-02	3.9178e-02	6.2578e-02
492 8.5399e+00 6.8006e+00 4.7254e-02 3.6687e-02 4.9934e-02 4.084							3.3145e-02
	_						2.5005e-02
1402   9 5000 0 100   4 9224 0 100   2 1149 - 00   4 7204 - 00   4 7207 00   0 777							4.0848e-02
	493	8.5099e+00	6.8336e+00	3.1148e-02	4.7384e-02	4.7297e-02	3.5754e-02
	$\rightarrow$						3.3290e-02
							2.7696e-02
							3.2458e-02
	_						3.6980e-02 3.5839e-02
	_						3.8751e-02
	_						3.7361e-02
Tabela 2: Wyniki - czas rozwiązywania układu równań ${\bf A_{III}}{\bf x}={\bf b}$ [s]			l .				



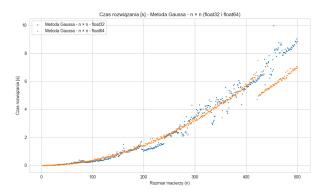
# 6.4. Wizualizacja wyników czasu rozwiązywania układu równań



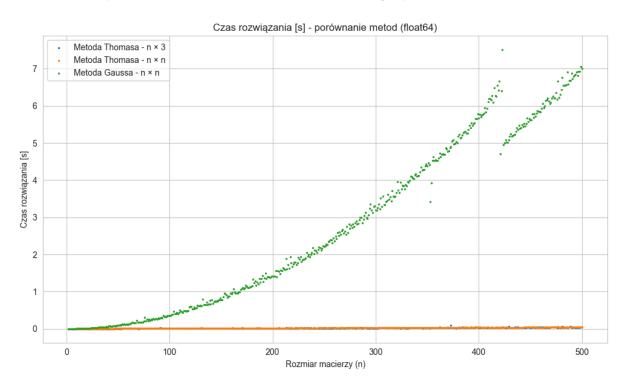


Rysunek 5: Czas rozwiązania metodą Thomasa  $\mathbf{A_{III}}^{n\times 3}$ dla precyzji float<br/>32 oraz float<br/>64.

Rysunek 6: Czas rozwiązania metodą Thomasa  $\mathbf{A_{III}}^{n \times n}$  dla precyzji float32 oraz float64.



Rysunek 7: Czas rozwiązania metodą Gaussa  $\mathbf{A_{III}}^{n\times n}$ dla precyzji float<br/>32 oraz float64.



Rysunek 8: Porównanie czasów rozwiązania  $\mathbf{A}_{\mathbf{III}}$ różnymi metodami dla precyzji float64.



## 6.5. Zużycie pamięci

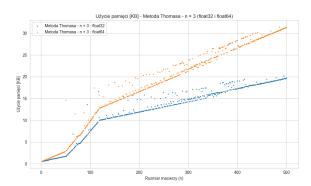
	]	życia pamięci v Precyzja float3:	2	1	Precyzja float6	4
	$\mathbf{A_{III}}^{n\times 3}$	$\mathbf{A}_{\mathbf{III}}^{n \times n}$	$\mathbf{A_{III}}^{n \times n}$	$\mathbf{A_{III}}^{n \times 3}$	$\mathbf{A}_{\mathrm{III}}^{n \times n}$	$\mathbf{A_{III}}^{n \times n}$
n	Metoda Thomasa	Metoda Thomasa	Metoda Gaussa	Metoda Thomasa	Metoda Thomasa	Metoda Gaussa
2	8.5156e-01	8.9062e-01	6.1719e-01	6.5625e-01	5.7031e-01	6.1719e-0
3	1.2949e+00	9.5312e-01	1.0605e+00	7.1875e-01	5.9375e-01	6.6406e-0
4	9.2188e-01	1.0312e+00	6.8750e-01	7.9688e-01	6.1719e-01	7.1094e-0
5	9.6875e-01	1.1250e+00	7.3438e-01	8.9062e-01	6.4062e-01	7.5781e-0
6	1.0234e+00	1.2344e+00	7.8906e-01	1.0000e+00	6.6406e-01	8.0469e-0
7	1.0859e+00	1.3594e+00	8.5156e-01	1.1250e+00	6.8750e-01	8.5156e-0
8	1.1562e+00	1.5000e+00	9.2188e-01	1.2656e+00	7.1094e-01	8.9844e-0
9	1.2344e+00	1.6562e+00	1.0000e+00	1.4219e+00	7.3438e-01	9.4531e-0
10	1.3203e+00	1.8281e+00	1.0859e+00	1.5938e+00	7.5781e-01	9.9219e-0
11	1.4141e+00	2.0156e+00	1.1797e+00	1.7812e+00	7.8125e-01	1.0391e+0
12	1.5156e+00	2.2188e+00	1.2812e+00	1.9844e+00	8.0469e-01	1.0859e+0
13	1.6250e+00	2.4375e+00	1.3906e+00	2.2031e+00	8.2812e-01	1.1328e+0
14	1.7422e+00	2.6719e+00	1.5078e+00	2.4375e+00	8.5156e-01	1.1797e+0
15	1.8672e+00	2.9219e+00	1.6328e+00	2.6875e+00	8.7500e-01	1.2266e+0
16	2.0000e+00	3.1875e+00	1.7656e+00	2.9531e+00	9.4531e-01	1.2734e+0
17	2.1406e+00	3.4688e+00	1.9062e+00	3.2344e+00	9.6875e-01	1.3203e+0
18	2.2891e+00	3.7656e+00	2.0547e+00	3.5312e+00	9.9219e-01	1.3672e+0
19	2.4453e+00	4.0781e+00	2.2109e+00	3.8438e+00	1.0156e+00	1.4141e+0
20	2.6094e+00	4.4062e+00	2.3750e+00	4.1719e+00	1.0391e+00	1.4609e+0
21	2.7812e+00	4.7500e+00	2.5469e+00	4.5156e+00	1.0625e+00	1.5078e+0
22	2.9609e+00 9.7598e+00	5.1094e+00	2.7266e+00 2.9141e+00	4.8750e+00	1.0859e+00	1.5547e+0 1.6016e+0
23		5.4844e+00 6.6787e+00		5.2500e+00	1.1094e+00	1.6016e+0
24	3.3438e+00 3.5469e+00	7.3359e+00	3.1094e+00 3.3125e+00	5.6406e+00 6.0469e+00	1.1328e+00 1.1562e+00	1.6484e+0 1.6953e+0
25 26	3.5469e+00 3.8955e+00	7.3359e+00 6.8408e+00	3.3125e+00 3.5234e+00	6.0469e+00 6.4688e+00	1.1562e+00 1.1797e+00	1.6953e+0 1.7422e+0
27	3.9766e+00	7.1406e+00	3.7422e+00	6.9062e+00	1.1/9/e+00 1.2031e+00	1.7422e+0 1.7891e+0
28	4.2031e+00	7.1406e+00 7.5938e+00	3.9688e+00	7.3594e+00	1.2266e+00	1.7891e+0 1.8359e+0
29	4.4375e+00	8.0625e+00	4.2031e+00	7.8281e+00	1.2500e+00	1.8828e+0
30	4.6797e+00	8.5469e+00	4.4453e+00	8.3125e+00	1.2734e+00	1.9297e+0
31	4.9297e+00	1.2919e+01	4.6953e+00	8.8125e+00	1.2969e+00	1.9766e+0
32	8.5625e+00	1.0021e+01	4.9531e+00	9.3281e+00	1.3203e+00	2.0234e+0
33	5.8652e+00	1.0094e+01	5.2188e+00	9.8594e+00	1.3438e+00	2.0703e+0
34	5.7266e+00	1.0641e+01	5.4922e+00	1.0406e+01	1.3672e+00	2.1172e+0
35	8.7656e+00	1.1203e+01	5.7734e+00	1.0969e+01	1.3906e+00	2.1641e+0
36	6.8721e+00	1.2305e+01	6.0625e+00	1.1547e+01	1.4141e+00	2.2109e+0
37	6.5938e+00	1.2375e+01	6.3594e+00	1.2141e+01	1.4375e+00	2.2578e+0
38	6.8984e+00	1.2984e+01	6.6641e+00	1.2750e+01	1.4609e+00	2.3047e+0
39	9.1963e+00	1.3609e+01	6.9766e+00	1.3375e+01	1.4844e+00	2.3516e+0
40	7.9434e+00	1.7437e+01	7.2969e+00	1.4016e+01	1.5078e+00	2.3984e+0
41	7.8594e+00	1.5593e+01	7.6250e+00	1.4672e+01	1.5312e+00	2.4453e+0
42	8.1953e+00	1.6036e+01	7.9609e+00	1.5344e+01	1.5547e+00	2.4922e+0
43	9.1797e+00	1.6266e+01	8.3047e+00	1.6031e+01	1.5781e+00	2.5391e+0
44	8.8906e+00	1.6969e+01	8.6562e+00	1.6734e+01	1.6016e+00	2.5859e+0
45	9.2500e+00	2.0640e+01	9.0156e+00	1.7453e+01	1.6250e+00	2.6328e+0
46	1.0258e+01	1.8834e+01	9.3828e+00	1.8188e+01	1.6484e+00	2.6797e+0
47	1.0404e+01	1.9172e+01	9.7578e+00	1.8938e+01	1.6719e+00	2.7266e+0
48	1.0375e+01	2.1832e+01	1.0164e+01	1.9703e+01	1.6953e+00	2.7734e+0
49	1.1283e+01	2.1177e+01	1.0578e+01	2.0484e+01	1.7188e+00	2.8203e+0
50	1.1211e+01	2.1539e+01	1.0977e+01	2.1328e+01	1.7422e+00	1.4615e+0
51	2.5728e+02	5.0620e+02	2.5634e+02	5.0711e+02	1.3125e+01	1.9544e+0
52	2.5728e+02 2.5902e+02	5.0620e+02 5.1010e+02	2.5878e+02	5.0711e+02 5.0979e+02	1.3125e+01 1.3148e+01	1.9544e+0 1.9055e+0
53	2.6116e+02	5.1010e+02 5.1505e+02	2.6071e+02	5.0979e+02 5.1330e+02	1.3148e+01 1.3172e+01	1.9055e+0 1.9102e+0
54	2.6373e+02	5.1810e+02	2.6229e+02	5.1728e+02	1.5246e+01	2.1815e+0
55	2.6511e+02	5.2194e+02	2.6429e+02	5.2184e+02	1.3755e+01	1.9195e+0
56	2.6724e+02	5.2612e+02	2.6688e+02	5.2581e+02	1.3242e+01	1.9242e+0
57	2.6902e+02	5.3079e+02	2.6831e+02	5.2933e+02	1.3266e+01	1.9289e+0
58	2.7166e+02	5.3420e+02	2.7034e+02	5.3394e+02	1.3289e+01	2.1850e+0
59	2.7319e+02	5.3833e+02	2.7237e+02	5.3744e+02	1.6034e+01	1.9383e+0
60	2.7523e+02	5.4241e+02	2.7492e+02	5.4152e+02	1.3850e+01	1.9430e+0
61	2.7727e+02	5.4695e+02	2.7645e+02	5.4798e+02	1.3359e+01	2.1271e+0
62	2.7940e+02	5.5049e+02	2.7851e+02	5.5021e+02	1.3383e+01	1.9523e+0
63	2.8127e+02	5.5462e+02	2.8057e+02	5.5384e+02	1.3406e+01	2.0106e+0
64	2.8346e+02	5.5880e+02	2.8515e+02	5.5857e+02	1.4320e+01	1.9617e+0
65	2.8561e+02	5.6353e+02	2.8472e+02	5.6265e+02	1.3865e+01	1.9664e+0
66	2.8757e+02	5.6713e+02	2.8680e+02	5.6631e+02	1.3477e+01	2.0244e+0
267	2.9041e+02	5.7115e+02	2.9162e+02	5.7106e+02	1.3500e+01	1.9758e+0
68	2.9182e+02	5.7565e+02	2.9152e+02	5.7470e+02	1.6415e+01	1.9805e+0
69	2.9393e+02	5.8026e+02	2.9311e+02	5.8124e+02	1.4372e+01	2.2544e+0
70	2.9694e+02	5.8392e+02	2.9523e+02	5.8357e+02	1.3570e+01	2.0458e+0
71	2.9817e+02	5.8823e+02	2.9794e+02	5.8741e+02	1.3594e+01	1.9945e+0
72	3.0026e+02	5.9256e+02	2.9948e+02	5.9229e+02	1.3617e+01	1.9992e+0
73	3.0245e+02	5.9677e+02	3.0162e+02	5.9637e+02	1.6308e+01	2.2646e+0
74	3.0512e+02	6.0107e+02	3.0429e+02	6.0275e+02	1.3664e+01	2.0086e+0
75	3.0680e+02	6.0521e+02	3.0593e+02	6.0514e+02	1.3688e+01	2.0133e+0
.,,						

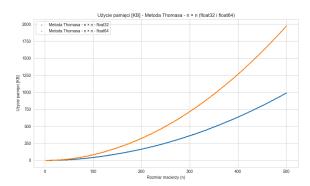
		życia pamięci w Precyzja float32		ej przez program dla macierzy A <sub>III</sub> [kB] Precyzja float64			
n	A <sub>III</sub> <sup>n×3</sup> Metoda Thomasa	A <sub>III</sub> <sup>n×n</sup> Metoda Thomasa	A <sub>III</sub> <sup>n×n</sup> Metoda Gaussa	A <sub>III</sub> <sup>n×3</sup> Metoda Thomasa	A <sub>III</sub> <sup>n×n</sup> Metoda Thomasa	A <sub>III</sub> <sup>n×n</sup> Metoda Gaussa	
277	3.1110e+02	6.1405e+02	3.1081e+02	6.1565e+02	1.5685e+01	2.0740e+01	
278	3.1339e+02	6.1848e+02	3.1245e+02	6.1811e+02	1.4271e+01	2.0273e+01	
279	3.1615e+02	6.2274e+02	3.1514e+02	6.2197e+02	1.3781e+01	2.0908e+01	
280	3.1765e+02	6.2758e+02	3.1683e+02	6.2871e+02	1.3805e+01	2.0367e+01	
281 282	3.1985e+02 3.2254e+02	6.3159e+02 6.3602e+02	3.2126e+02 3.2124e+02	6.3127e+02 6.3519e+02	1.4533e+01 1.3852e+01	2.0414e+01 2.2927e+01	
283	3.2436e+02	6.4102e+02	3.2124e+02 3.2346e+02	6.4016e+02	1.3875e+01	2.0508e+01	
284	3.2658e+02	6.4485e+02	3.2633e+02	6.4408e+02	1.3898e+01	2.3071e+01	
285	3.2871e+02	6.4937e+02	3.2792e+02	6.4855e+02	1.4812e+01	2.1138e+01	
286	3.3145e+02	6.5459e+02	3.3267e+02	6.5359e+02	1.4459e+01	2.3165e+01	
287	3.3323e+02	6.5840e+02	3.3295e+02	6.5753e+02	1.3969e+01	2.1177e+01	
288	3.3549e+02	6.6287e+02	3.3467e+02	6.6261e+02	1.6684e+01	2.3446e+01	
289	3.3835e+02	6.6740e+02	3.3758e+02	6.6658e+02	1.4810e+01	2.1325e+01	
290 291	3.3986e+02 3.4244e+02	6.7252e+02 6.7651e+02	3.3921e+02 3.4205e+02	6.7169e+02 6.7569e+02	1.4039e+01 1.4062e+01	2.3139e+01 2.1341e+01	
292	3.4517e+02	6.8097e+02	3.4429e+02	6.8251e+02	1.4898e+01	2.2679e+01	
293	3.4690e+02	6.8637e+02	3.4858e+02	6.8532e+02	1.4623e+01	2.1536e+01	
294	3.4908e+02	6.9029e+02	3.4884e+02	6.9003e+02	1.4133e+01	2.1023e+01	
295	3.5221e+02	6.9492e+02	3.5299e+02	6.9451e+02	1.6489e+01	2.1766e+01	
296	3.5386e+02	7.0012e+02	3.5402e+02	6.9932e+02	1.4180e+01	2.1117e+01	
297	3.5605e+02	7.0428e+02	3.5585e+02	7.0390e+02	1.6720e+01	2.2913e+01	
298	3.5900e+02	7.0888e+02	3.5768e+02	7.1031e+02	1.4880e+01	2.1771e+01	
299	3.6084e+02	7.1402e+02	3.6232e+02	7.1319e+02	1.4250e+01	2.1258e+01	
300	3.6320e+02	7.1816e+02	3.6279e+02	7.1804e+02	1.4914e+01	2.1763e+01	
451	8.0789e+02	1.6082e+03	8.0776e+02	1.6076e+03	1.8531e+01	2.9095e+01	
452	8.1219e+02	1.6156e+03	8.1122e+02	1.6147e+03	1.8555e+01	2.9072e+01	
453	8.1540e+02	1.6218e+03	8.1487e+02	1.6218e+03	1.8532e+01	2.9119e+01	
454	8.1910e+02	1.6295e+03	8.1896e+02	1.6290e+03	1.8549e+01	2.9189e+01	
455	8.2256e+02	1.6361e+03	8.2203e+02	1.6360e+03	1.8595e+01	2.9236e+01	
456	8.2618e+02	1.6437e+03	8.2556e+02	1.6431e+03	1.8618e+01	2.9382e+01	
457	8.2974e+02	1.6509e+03	8.2918e+02	1.6503e+03	1.8648e+01	2.9429e+01	
458	8.3291e+02	1.6575e+03	8.3272e+02	1.6574e+03	1.8665e+01	2.9377e+01	
459	8.3711e+02	1.6652e+03	8.3634e+02	1.6646e+03	1.8765e+01	2.9499e+01	
460	8.4065e+02	1.6725e+03	8.3992e+02	1.6719e+03	1.9437e+01	2.9517e+01	
461	8.4410e+02	1.6791e+03	8.4362e+02	1.6791e+03	1.8759e+01	2.9547e+01	
462 463	8.4810e+02 8.5150e+02	1.6868e+03 1.6936e+03	8.4719e+02 8.5074e+02	1.6864e+03 1.6941e+03	1.8736e+01 1.8806e+01	2.9617e+01 2.9710e+01	
464	8.5508e+02	1.7014e+03	8.5440e+02	1.7008e+03	1.8783e+01	2.9711e+01	
465	8.5867e+02	1.7087e+03	8.5814e+02	1.7081e+03	1.8807e+01	2.9804e+01	
466	8.6181e+02	1.7155e+03	8.6174e+02	1.7154e+03	1.8830e+01	2.9729e+01	
467	8.6603e+02	1.7236e+03	8.6540e+02	1.7227e+03	1.8854e+01	2.9779e+01	
468	8.6966e+02	1.7306e+03	8.6901e+02	1.7301e+03	1.8976e+01	3.0538e+01	
469	8.7331e+02	1.7374e+03	8.7276e+02	1.7374e+03	1.8999e+01	2.9945e+01	
470	8.7699e+02	1.7454e+03	8.7646e+02	1.7448e+03	1.8953e+01	2.9939e+01	
471	8.8068e+02	1.7527e+03	8.8015e+02	1.7522e+03	1.8924e+01	2.9986e+01	
472	8.8471e+02	1.7595e+03	8.8375e+02 8.8807e+02	1.7595e+03	1.8971e+01	3.0010e+01	
473 474	8.8808e+02 8.9128e+02	1.7676e+03		1.7669e+03	1.9047e+01	3.0080e+01 3.0180e+01	
474	8.9128e+02 8.9551e+02	1.7743e+03 1.7818e+03	8.9126e+02 8.9493e+02	1.7744e+03 1.7818e+03	1.9018e+01 1.9140e+01	3.0180e+01 3.0227e+01	
476	8.9926e+02	1.7819e+03	8.9863e+02	1.7893e+03	1.9140e+01	3.0267e+01	
477	9.0302e+02	1.7973e+03	9.0237e+02	1.7968e+03	1.9134e+01	3.0268e+01	
478	9.0677e+02	1.8042e+03	9.0616e+02	1.8042e+03	1.9088e+01	3.0295e+01	
479	9.1049e+02	1.8122e+03	9.0988e+02	1.8117e+03	1.9783e+01	3.0361e+01	
480	9.1420e+02	1.8201e+03	9.1364e+02	1.8193e+03	1.9211e+01	3.0461e+01	
481	9.1752e+02	1.8268e+03	9.1743e+02	1.8268e+03	1.9182e+01	3.0455e+01	
482	9.2183e+02	1.8349e+03	9.2118e+02	1.8350e+03	1.9258e+01	3.0502e+01	
483	9.2588e+02	1.8425e+03	9.2494e+02	1.8419e+03	1.9229e+01	3.0602e+01	
484 485	9.2938e+02 9.3316e+02	1.8495e+03 1.8577e+03	9.2873e+02 9.3257e+02	1.8494e+03 1.8571e+03	1.9298e+01 1.9298e+01	3.0596e+01 3.0695e+01	
486	9.3316e+02 9.3698e+02	1.857/e+03 1.8653e+03	9.3640e+02	1.85/1e+03 1.8647e+03	1.9298e+01 1.9299e+01	3.1437e+01	
487	9.4080e+02	1.8723e+03	9.4016e+02	1.8723e+03	1.9299e+01 1.9276e+01	3.0736e+01	
488	9.4462e+02	1.8805e+03	9.4403e+02	1.8799e+03	1.9392e+01	3.0714e+01	
489	9.4791e+02	1.8881e+03	9.4781e+02	1.8876e+03	1.9369e+01	3.0929e+01	
490	9.5230e+02	1.8959e+03	9.5162e+02	1.8953e+03	1.9438e+01	3.0930e+01	
491	9.5612e+02	1.9030e+03	9.5612e+02	1.9029e+03	1.9416e+01	3.0977e+01	
492	9.5998e+02	1.9112e+03	9.5939e+02	1.9106e+03	1.9538e+01	3.1023e+01	
493	9.6412e+02	1.9192e+03	9.6320e+02	1.9183e+03	1.9562e+01	3.1040e+01	
494	9.6766e+02	1.9262e+03	9.6707e+02	1.9260e+03	1.9532e+01	3.1117e+01	
495	9.7160e+02	1.9344e+03	9.7090e+02	1.9338e+03	2.0211e+01	3.1210e+01	
496	9.7546e+02	1.9423e+03	9.7487e+02	1.9417e+03	1.9632e+01	3.1158e+01	
497 498	9.7930e+02	1.9501e+03	9.7867e+02	1.9494e+03	1.9586e+01	3.1188e+01	
498 499	9.8325e+02 9.8716e+02	1.9573e+03 1.9656e+03	9.8264e+02 9.8652e+02	1.9577e+03 1.9650e+03	1.9557e+01 1.9649e+01	3.1351e+01 3.1397e+01	
		5500-105		5500-105			

Tabela 3: Wyniki - zużycie pamięci podczas działania algorytmu rozwiązującego układ równań  ${\bf A_{III}}{\bf x}={\bf b}$  (przechowywanie macierzy + pamięć potrzebna do działania programu)



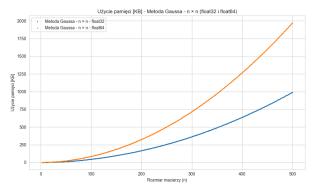
### 6.6. Wizualizacja wyników zużycia pamięci



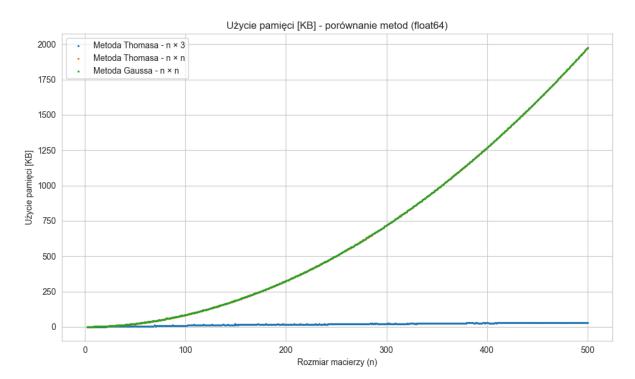


Rysunek 9: Zużycie pamięci [KB] dla metody Thomasa  ${\bf A_{III}}^{n imes3}$  dla precyzji float<br/>32 oraz float<br/>64.

Rysunek 10: Zużycie pamięci [KB] dla metody Thomasa  ${\bf A_{III}}^{n imes n}$  dla precyzji float<br/>32 oraz float<br/>64.



Rysunek 11: Zużycie pamięci [KB] dla metody Gaussa  $\mathbf{A_{III}}^{n \times n}$  dla precyzji float<br/>32 oraz float<br/>64.



Rysunek 12: Porównanie zużycia pamięci [KB]  ${f A}_{
m III}$  różnymi metodami dla precyzji float64.



#### 7. Wnioski

#### Efektywność obliczeniowa

Metoda Thomasa, dedykowana dla macierzy trójdiagonalnych, wykazała istotnie wyższą wydajność obliczeniową względem klasycznej metody eliminacji Gaussa. Czas rozwiązania układu równań przy użyciu metody Thomasa był zauważalnie krótszy, co jest szczególnie widoczne dla większych rozmiarów macierzy ( $n \to 500$ ). Potwierdza to teoretyczne złożoności czasowe algorytmu Gaussa  $\mathrm{O}(n^3)$  oraz Thomasa O(n).

#### Zużycie pamięci operacyjnej

Skalowanie zużycia pamięci potwierdza teoretyczne złożoności: Dla metody Gaussa  $n \times n$  i Thomasa  $n \times n$  zużycie pamięci (Tabela 3) rośnie znacznie szybciej niż dla Thomasa  $n \times 3$ . Dla n = 500 (float64), Gauss zajmuje ok. 1972 kB, a Thomas  $n \times n$  ok. 1973 kB. To obrazuje złożoność O  $\binom{n^2}{2}$  związaną z przechowywaniem pełnej macierzy. Wykresy (Rysunki 10 i 11) powinny pokazywać paraboliczny wzrost.

W przypadku metody Thomasa  $n \times 3$ , dla n=500 (float64), zużycie to tylko ok. 31 kB. Wzrost jest liniowy  $\mathrm{O}(n)$ , co czyni tę metodę wyjątkowo efektywną pamięciowo dla dużych, rzadkich macierzy trójdiagonalnych, co ilustruje Rysunek 9.

#### Dokładność numeryczna

Rodzaj zastosowane metody, Gaussa lub Thomasa, nie wpłynął na granicę błędu dla danej precyzji. Z Tabela 2 widać, że dla float32 wszystkie metody (Thomas  $n \times 3$ , Thomas  $n \times n$ , Gauss  $n \times n$ ) osiągają błąd rzędu  $\approx 1.19 \cdot 10^{-7}$ . Dla float64, wszystkie metody osiągają błąd rzędu  $2.22 \cdot 10^{-16}$  lub  $4.44 \cdot 10^{-16}$ . Oznacza to, że fundamentalnym ograniczeniem dokładności jest typ danych, a nie sam algorytm (pod warunkiem jego stabilności numerycznej, co w tym przypadku jest spełnione).

#### Zgodność wyników z oczekiwaniami teoretycznymi

Wyniki eksperymentalne w pełni potwierdziły właściwości teoretyczne obu metod: specjalizowana metoda Thomasa okazała się bardziej wydajna dla macierzy rzadkich o strukturze trójdiagonalnej, podczas gdy metoda Gaussa, mimo swojej uniwersalności, charakteryzowała się większym kosztem obliczeniowym i pamięciowym.