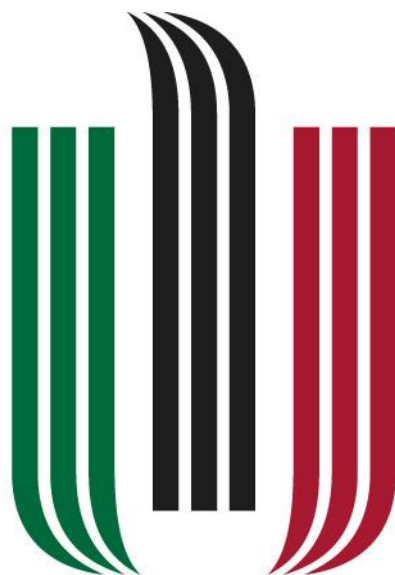


<i>Imię i nazwisko</i> Jarosław Bednarczyk	<i>Kierunek i grupa</i> IT lab01	<i>Data</i> 10.06.2022
<i>Nr i temat laboratorium</i> Laboratorium 12. Modelowanie przepływu krwi przez komorę sztucznego serca		



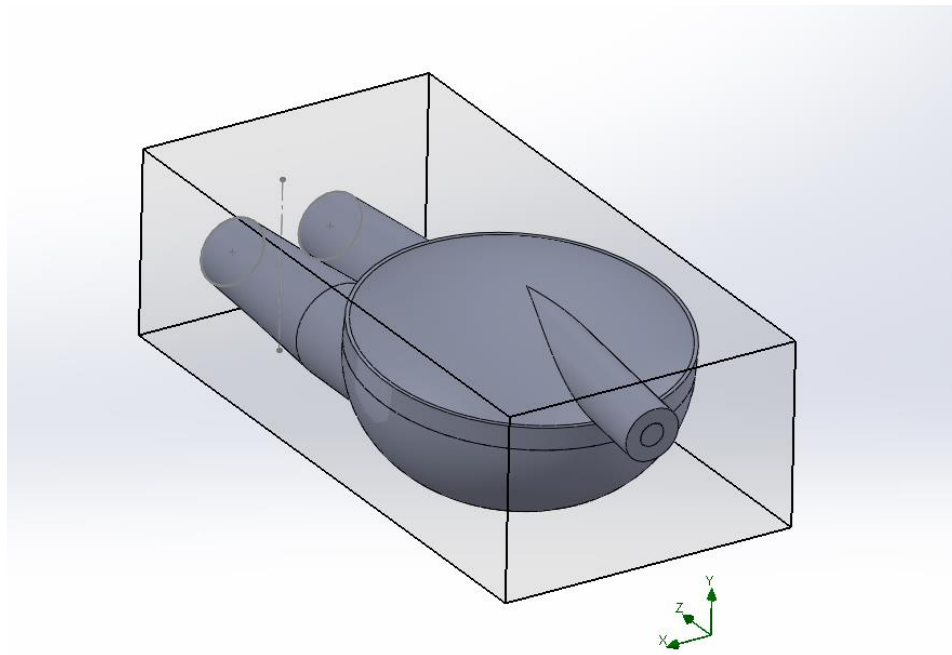
AGH

**AKADEMIA GÓRNICZO-HUTNICZA
IM. STANISŁAWA STASZICA
W KRAKOWIE**

- **Cel laboratorium**

Stworzenie uproszczonego modelu komory sztucznego serca, przeprowadzenie symulacji przepływu krwi oraz analiza uzyskanych danych.

1. Model



2. Symulacja przepływu – Wizard

Wizard - Unit System

Unit system:

System	Path	Comment
CGS (cm-g-s)	Pre-Defined	CGS (cm-g-s)
FPS (ft-lb-s)	Pre-Defined	FPS (ft-lb-s)
IPS (in-lb-s)	Pre-Defined	IPS (in-lb-s)
NMM (mm-g-s)	Pre-Defined	NMM (mm-g-s)
SI (m-kg-s)	Pre-Defined	SI (m-kg-s)
USA	Pre-Defined	USA

☐ Create new Name: SI (m-kg-s) (modified)

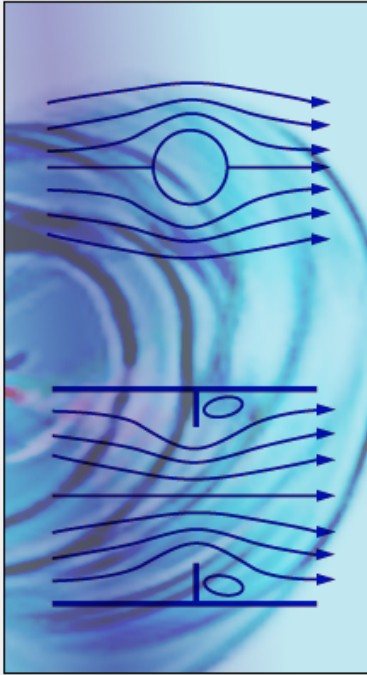
Parameter	Unit	Decimals in results display	1 SI unit equals to
Main			
Pressure & stress	Pa	.12	1
Velocity	m/s	.123	1
Mass	kg	.123	1
Length	m	.123	1
Temperature	K	.12	1
Physical time	s	.123	1
Percentage	%	12	1

< Back Next > Cancel Help

?

×

Wizard - Analysis Type



Analysis type

☒ Internal
 ☐ External

Consider closed cavities

☒ Exclude cavities without flow conditions
☐ Exclude internal space

Physical Features	Value
Heat conduction in solids	<input type="checkbox"/>
Radiation	<input type="checkbox"/>
Time-dependent	<input type="checkbox"/>
Gravity	<input type="checkbox"/>
Rotation	<input type="checkbox"/>
Free surface	<input type="checkbox"/>

Dependency...

< Back

Next >


Cancel

Help

?

×

Wizard - Default Fluid



Fluids

+

 Gases

+

 Liquids

Non-Newtonian Liquids

Pre-Defined

Apple Sauce

Pre-Defined

BASF 486M HIPS

Pre-Defined

Borealis HD601CF HoPP (8.0 MFR)

Pre-Defined

Borealis RD208CF CoPP (8 MFR)

Pre-Defined

Path

New...

Add

Remove

Project Fluids

Blood (Non-Newtonian Liquids)

Default Fluid

☒

Flow Characteristic	Value
Flow type	Laminar Only

< Back

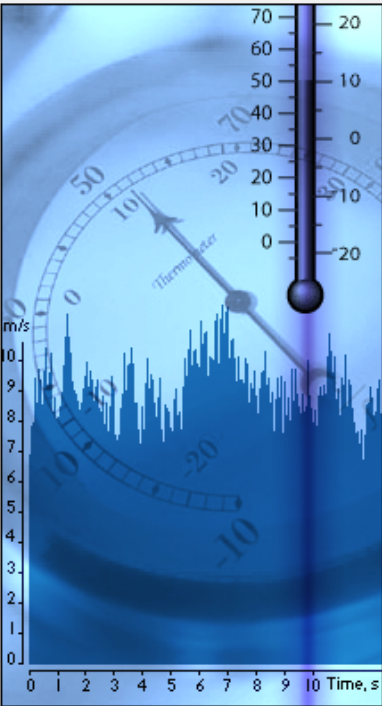
Next >

Cancel

Help

Wizard - Initial Conditions

? X



Parameter	Value
Parameter Definition	
User Defined	
Thermodynamic Parameters	
Pressure	15998.69 Pa
Temperature	309.75 K
Velocity Parameters	
Velocity in X direction	0 m/s
Velocity in Y direction	0 m/s
Velocity in Z direction	0 m/s

Coordinate System...

Dependency...

< Back

Finish

Cancel

Help

Solver: Blood Flow [Domyślna] (Złożenie1.SLDASM)
- □ X

File
Calculation
View
Insert
Window
Help

Info

Parameter	Value
Status	Solver is finished.
Total cells	4,215
Fluid cells	4,215
Fluid cells contacting solids	2,685
Iterations	41
Last iteration finished	14:48:22
CPU time per last iteration	00:00:01
Travels	1.025
Iterations per 1 travel	40
Cpu time	0 : 0 : 9
Calculation time left	0 : 0 : 0
Run at	DESKTOP-093490E
Number of cores	12

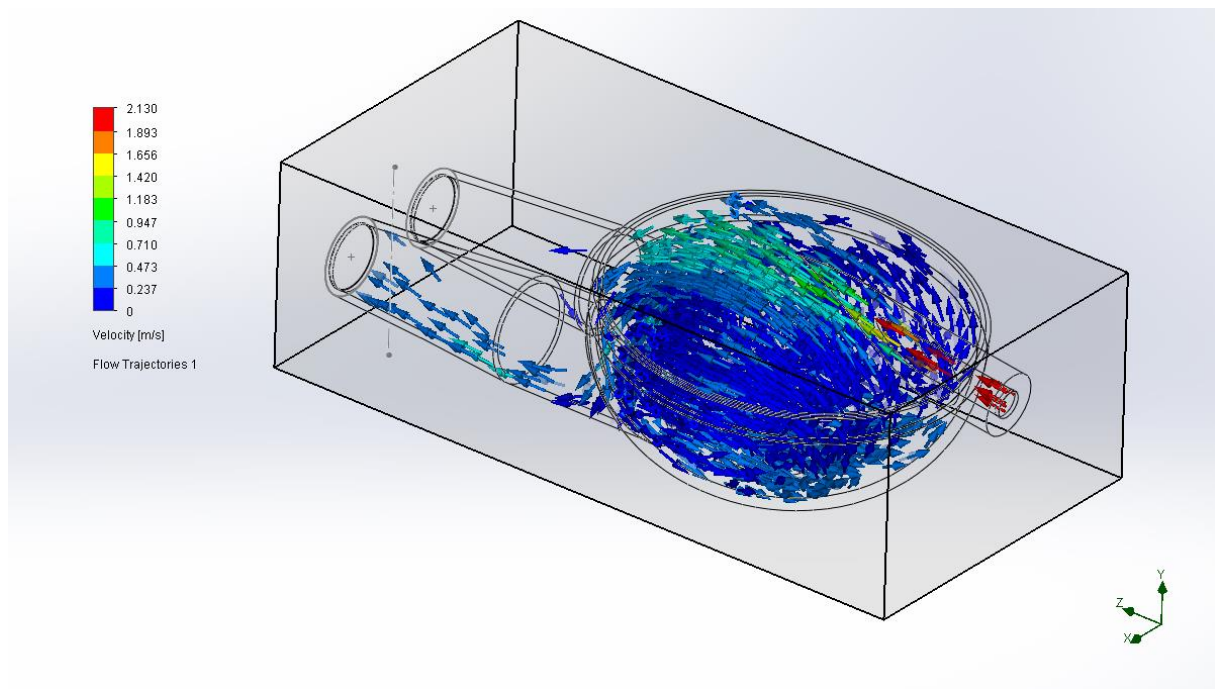
Warning	Comment
No warnings	

Log

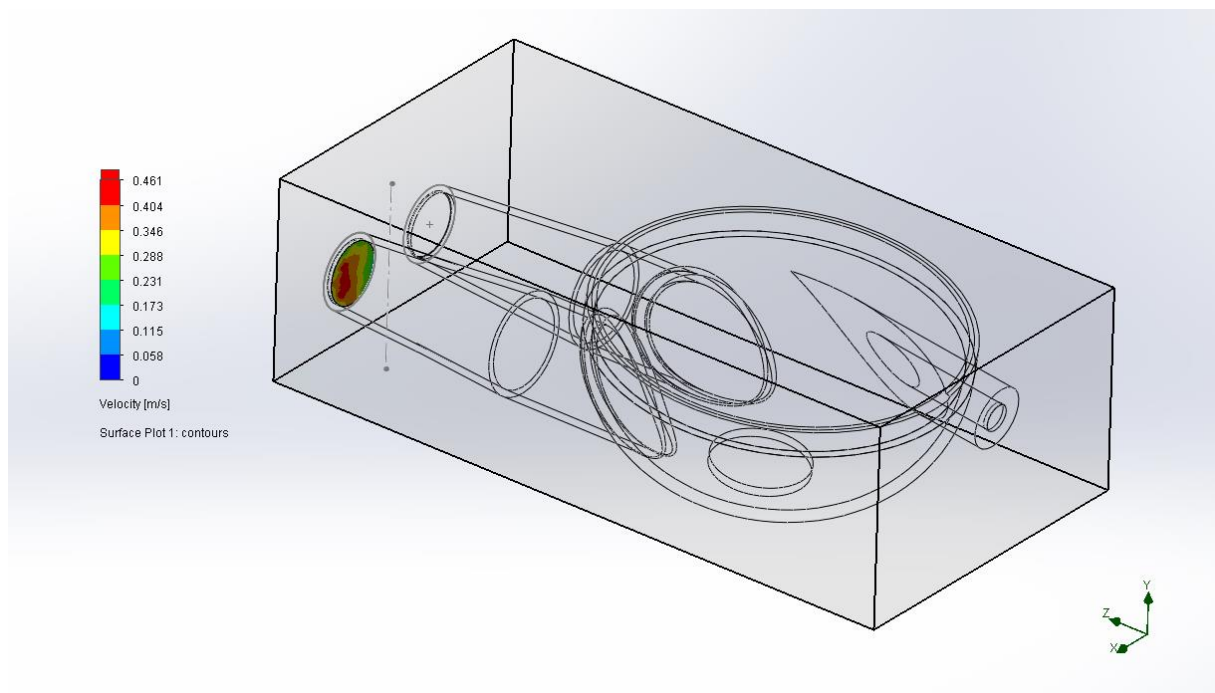
Event	Iteration	Time
Mesh generation started	0	14:48:09, Jun 17
Mesh generation normally finished	0	14:48:13, Jun 17
Preparing data for calculation	0	14:48:13, Jun 17
Calculation started	0	14:48:14, Jun 17
Calculation has converged since the following cr...	41	14:48:22, Jun 17
Goals are converged	41	
Calculation finished	41	14:48:22, Jun 17

Ready
Solver is finished. Iterations : 41

3. Wyniki – Flow Trajectories



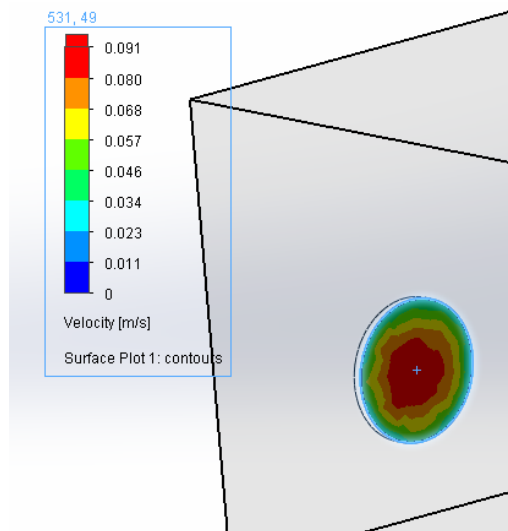
4. Wyniki – Surface Plot



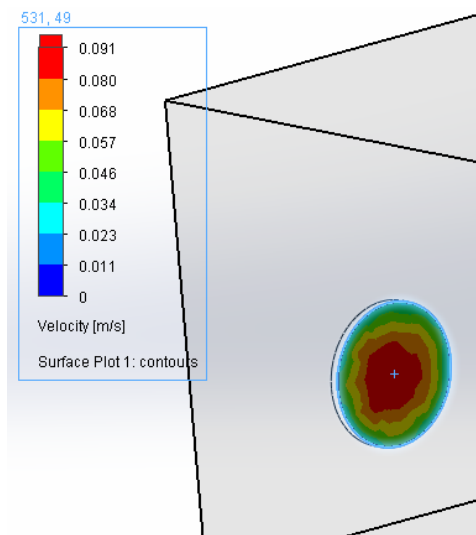
5. Zadanie

What If Analysis 1										
Input Variables Output Parameters Scenario Goals										
Run										
Summary	Design Point 1	Design Point 2	Design Point 3	Design Point 4	Design Point 5	Design Point 6	Design Point 7	Design Point 8	Design Point 9	Design Point 10
GG Average Velocity (Z) 1 [m/s]	0.00916570177	0.00915806514	0.00915717131	0.00914168998	0.00913467012	0.00913292099	0.00913858279	0.00913757831	0.00912403581	0.0091192691
GG Maximum Velocity (Z) 1 [m/s]	0.46864339	0.468256123	0.468241633	0.466477497	0.466586189	0.46674263	0.466395947	0.466716875	0.46719849	0.467408541
Status	Finished	Finished	Finished	Finished	Finished	Finished	Finished	Finished	Finished	Finished
Run at	This computer	This computer	This computer	This computer	This computer	This computer	This computer	This computer	This computer	This computer
Number of cores	12	12	12	12	12	12	12	12	12	12
Recalculate	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Take previous results	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Save full results	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Close Monitor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Calculation finished										

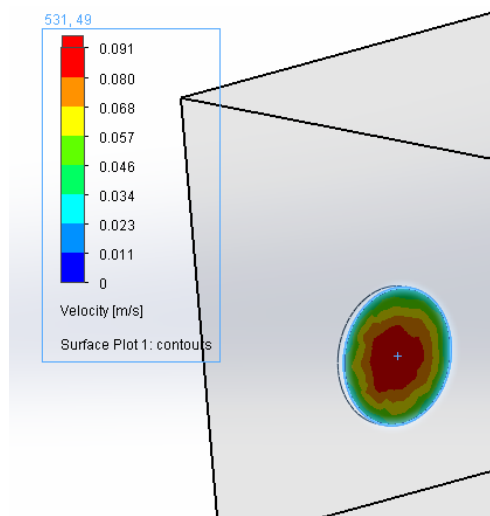
- 0,2 m/s



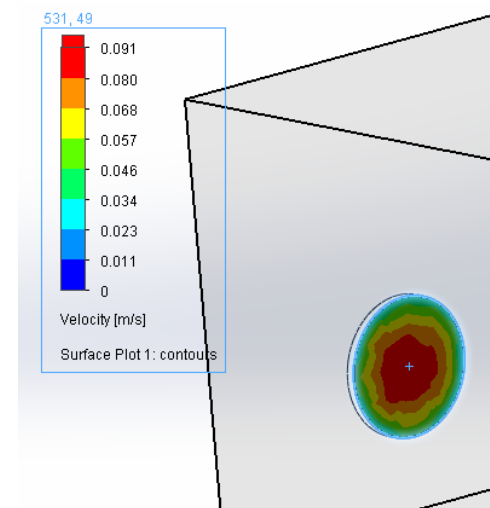
- 0,4 m/s



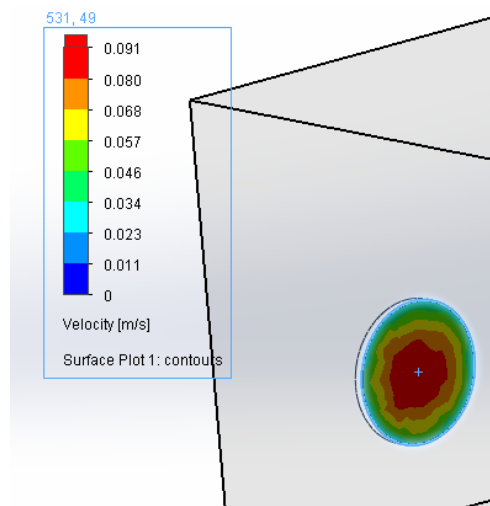
- 0,6 m/s



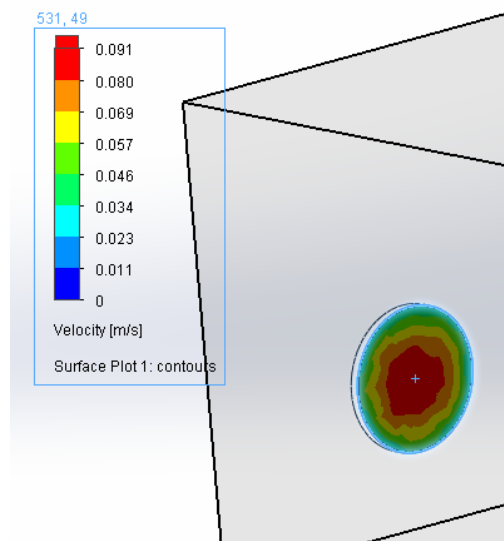
- 0,8 m/s



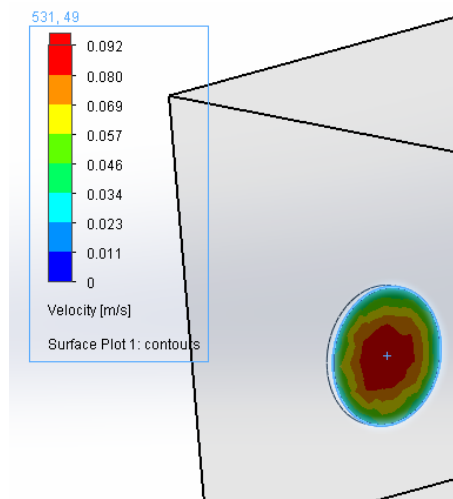
- 1 m/s



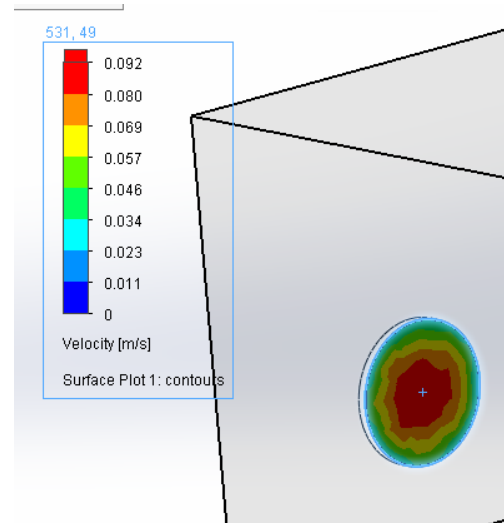
- 1,2 m/s



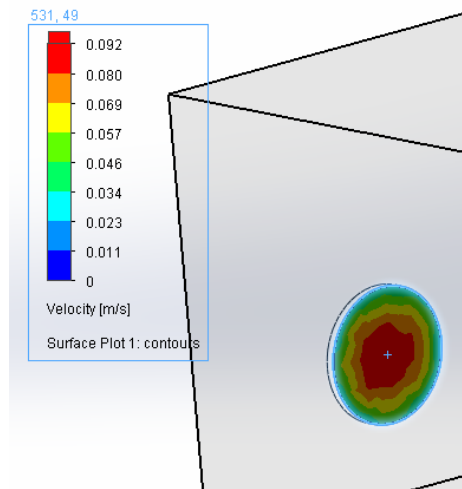
- 1,4 m/s



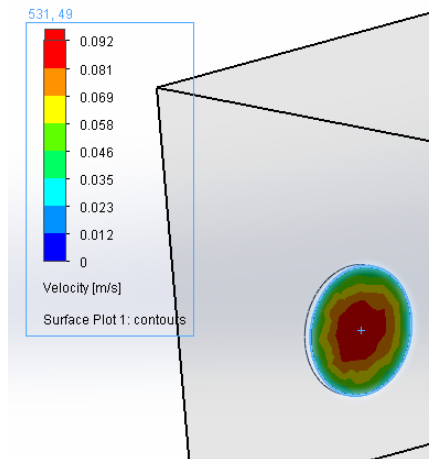
- 1,6 m/s



- 1,8 m/s



- 2 m/s



6. Obserwacje i wnioski

Otrzymane wyniki prawie nie różniły się przy każdej zmianie początkowej prędkości. Otrzymana maksymalna prędkość krwi wypływającej różni się zaledwie o 1% od tej przy najmniejszej prędkości. Oznaczać to może że prędkość jest za mała, by być w stanie znacznie wpłynąć na prędkość krwi wychodzącej, bądź budowa sztucznego serca jest tak dobrana, aby zminimalizować tą zmianę prędkości krwi.