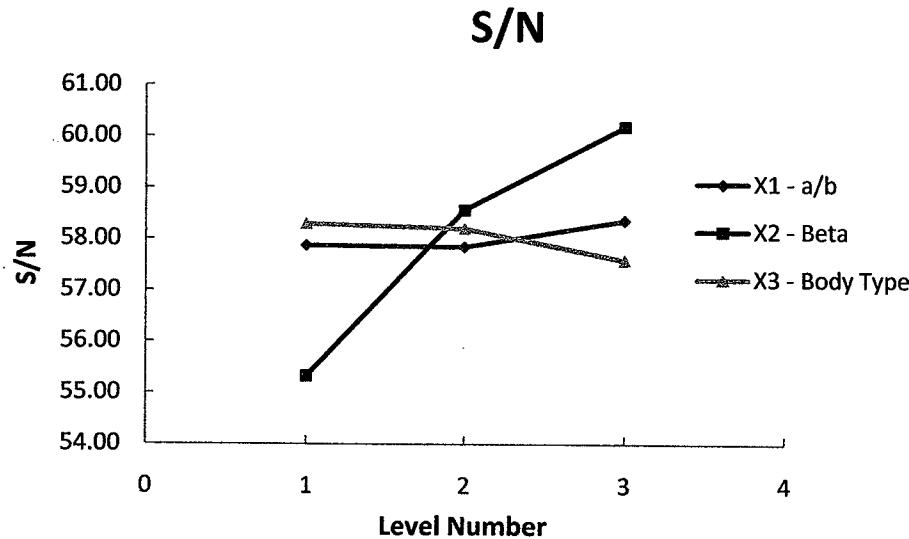


Taguchi Method

A)

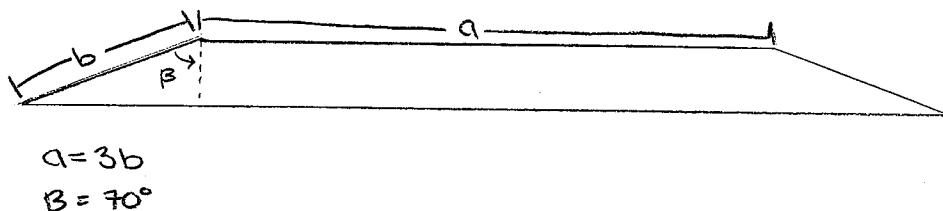
	X1	X2	X3	X4	S/N
1	588.8877	610.6192	610.6192	571.1305	55.4847
2	794.5170	823.8368	823.8368	770.5594	58.0861
3	997.8669	1034.6908	1034.6908	967.7775	60.0655
4	506.9895	525.6987	525.6987	491.7019	54.1840
5	895.4306	928.4744	928.4744	868.4301	59.1247
6	1017.3434	1054.8861	1054.8861	986.6668	60.2334
7	646.9179	670.7909	670.7909	627.4109	56.3010
8	833.4538	864.2104	864.2104	808.3221	58.5017
9	1023.7558	1061.5350	1061.5350	992.8857	60.2880

B)



- C) The most robust design parameter combination is when $a/b=3$, $\beta=70^*$, and the body type is a 3-D trapezoid. These all correspond to the highest value on the S/N graph for each parameter. ✓

- D) Sketch below

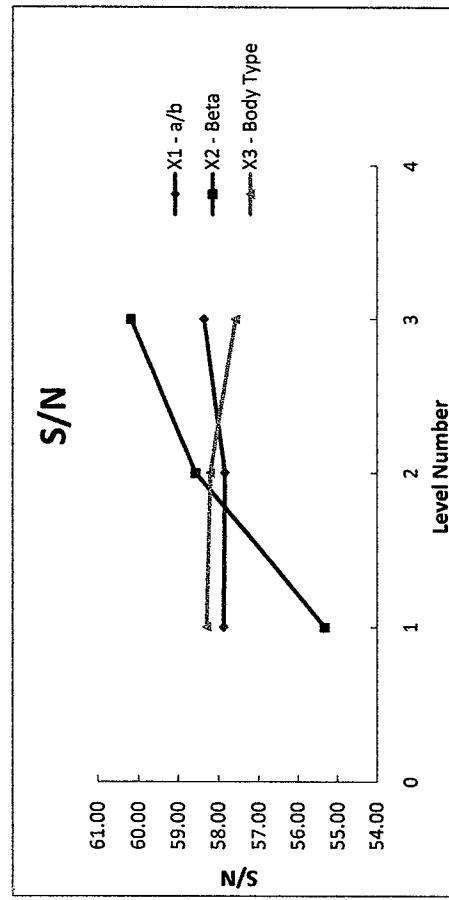


- E) The results in part (c) and (d) make sense because a large beta will cause the top surface area to be larger and therefore be able to collect more sunlight and generate more power. Also, the large beta will allow more sunlight to be collected when the solar panels are not perpendicular to the sun. The panels could be rotated slightly away from the sun which would cause the beta-angled sides of the spacecraft to collect more light. The a/b ratio of 3 and a 3-D trapezoidal body type cause the largest surface area on the top of the spacecraft. This will allow for more sunlight and therefore more power.
- F) Another design consideration that could influence the vehicle configuration could be the thermal system. All the other subsystems have a range of temperatures they can operate in so they must be located in the spacecraft in such a way that the sensitive systems are shielded the most. The placement of the systems could influence the vehicle configuration as a whole. If the Taguchi Method is used on the thermal system, the quality characteristic would be to minimize the overall change in temperature experienced by the spacecraft. The top three design parameters would be the power the thermal system takes, the percent of other systems it can keep steady, and the type of thermal conditioning, active or inactive.
- G) The Taguchi Method is a very helpful method of determining robust design but its method seems a little odd to me. It is helpful because not only is it rather simple to implement and you can determine the most robust design parameters, but you can also easily see which variables need to be constricted the most. In the example done in this homework, I noticed that the a/b ratio and the body type could change and not effect the signal to noise ratio much, but if beta were to change, then the signal to noise ratio changed a significant amount. This is very useful information because it allows the designer to know that beta must be constricted to 70° to get a good power output. While the Taguchi Method outputs helpful data, the method of calculating that data seems strange to me. I understand that you do not want to test every single case because of scheduling and cost constraints, but how and why are certain cases chosen? Also, what is the likelihood that the most robust design is overlooked because it occurs with a case that was not tested? These two questions make me wonder if the Taguchi Method will work well in most cases.
- H) See attached for TK Solver code.
cool!

Very good questions
and observations.
one by my office
id we can talk
about this (if you're
interested).

		N3	0.025	0.035	0.035	0.025
	X1	X2	X4	10	0	gamma
	1	1	20	Trap	0	10
1	1	1	45	Pyram	588.8876848998	610.6191818238
2	1	1	70	Cone	794.5170479617	823.8366065959
3	1	2	20	Cone	997.8869028924	1034.6908034202
4	2	2	45	Trap	506.9895073592	525.6987471722
5	2	2	70	Pyram	895.4306214212	928.4743550466
6	2	3	20	Pyram	1017.3434152576	1054.8860500694
7	3	3	45	Cone	646.9178877868	670.7908510853
8	3	3	70	Trap	833.4537964196	864.2104229846
9	a/b	beta			1023.7557502940	1061.5350170522
				body type		992.8857371762
						60.2879839784

Level	X1	X2	X3
1	57.8787789674	55.32232609182	58.2991286856
2	57.8473801746	58.5708348394	58.2068566198
3	58.3635705168	60.1956339012	57.5837443534



Status	Rule
* Unsatisfied	SATrap= $a^2+2*a*b$
* Unsatisfied	AnTrap1= $a^2*cos(\theta)*cos(\phi)$
* Unsatisfied	AnTrap2= $a*b*cos(pi)/2-\beta-\theta)*cos(\phi)$
* Unsatisfied	AnTrap3= $a*b*cos(pi)/2-\beta+\theta)*cos(\phi)$
* Unsatisfied	AnTrap=AnTrap1+AnTrap2+AnTrap3
* Unsatisfied	X1=a/b
* Unsatisfied	X2= $\beta*(180/\pi)$
* Unsatisfied	X3=BodyType
* Unsatisfied	N1= $\theta*(180/\pi)$
* Unsatisfied	N2= $\phi*(180/\pi)$
* Unsatisfied	N3=y
* Unsatisfied	PowerTrap=(S((1-y)^years)*(AnTrap)*((1.4959787*10^8)/148107600)^2

Status	Input	Name	Output	Unit	Comment
	5	years			
	3.14159265	π			
	302	S			
	3	X1			
	20	X2			
		β	.34906585		
'Pyrim		X3			
		BodyType	'Pyrim		
	10	N1			
		θ	.174532925		
	10	N2			
		ϕ	.174532925		
	.025	N3			
		γ	.025		
	a	1.119021688			
	b	.3730072228			
	3	SAPyrim			
		AnPyrim1	1.21445079		
		AnPyrim2	.215154701		
		AnPyrim3	.074722443		
		AnPyrim4	.215154701		
		AnPyrim5	.074722443		
		AnPyrim	1.79420508		
		PowerPyri	627.410927		

Status	Rule
* Unsatisfied	SAPyrim=a^2+4*(a*b*cos(β)+b^2*sin(β)*cos(β))
* Unsatisfied	AnPyrim1=a^2*cos(θ)*cos(Φ)
* Unsatisfied	AnPyrim2=(a*b*cos(β)+b^2*sin(β)*cos(β))*cos(π/2-β-θ)*cos(Φ)
* Unsatisfied	AnPyrim3=(a*b*cos(β)+b^2*sin(β)*cos(β))*cos(π/2-β+θ)*cos(Φ)
* Unsatisfied	AnPyrim=AnPyrim1+AnPyrim2+AnPyrim3+AnPyrim4+AnPyrim5
* Unsatisfied	X1=a/b
* Unsatisfied	X2=β*(180/π)
* Unsatisfied	X3=BodyType
* Unsatisfied	N1=θ*(180/π)
* Unsatisfied	N2=Φ*(180/π)
* Unsatisfied	N3=γ
* Unsatisfied	PowerPyrim=(S((1-γ)^years)*(AnPyrim)*((1.4959787*10^8)/148107600)^2
* Unsatisfied	AnPyrim4=(a*b*cos(β)+b^2*sin(β)*cos(β))*cos(π/2-β-Φ)*cos(θ)
* Unsatisfied	AnPyrim5=(a*b*cos(β)+b^2*sin(β)*cos(β))*cos(π/2-β+Φ)*cos(θ)

Status	Rule
* Unsatisfied	$SACone=\pi^*(a/2)^*2+\pi^*b^*(2^*a-b^*\sin(\beta))$
* Unsatisfied	$AnCone1=\pi^*(a/2)^*2^*\cos(\theta)^*\cos(\phi)$
* Unsatisfied	$AnCone2=\pi^*b^*(2^*a-b^*\sin(\beta))^*\sin(\beta)^*\cos(\theta)^*\cos(\phi)$
* Unsatisfied	X1=a/b
* Unsatisfied	X2=β*(180/π)
* Unsatisfied	X3=BodyType
* Unsatisfied	N1=θ*(180/π)
* Unsatisfied	N2=Φ*(180/π)
* Unsatisfied	N3=y
* Unsatisfied	$PowerCone=(S/(1-y)^*\text{years})^*(AnCone)^*((1.4959787*10^18)/(148107600)^2$
* Unsatisfied	AnCone=AnCone1+AnCone2