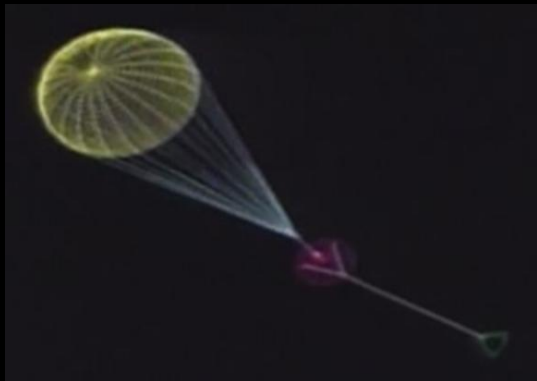




화성탐사선 착륙 프로젝트

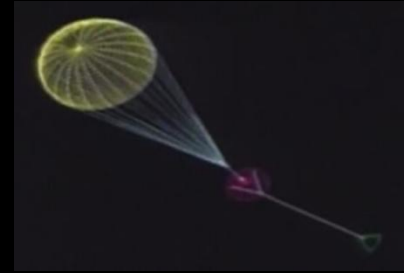
스피릿호의 낙하산 설계

조명 : AMOLED

2005006326 최종국

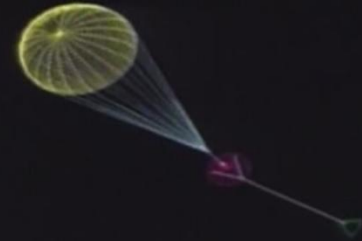
2005007277 오유석

❖ Contents



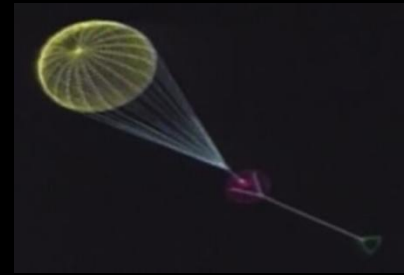
- 팀 소개
- 설계
 - 주제선정 배경
 - 문제정의(정식화 5단계)
- 해 찾기
 - Graphical method

■ 팀 소개

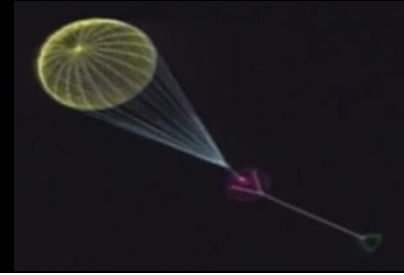


보석보다 빛나는
AMOLED

■ 주제 선정 배경



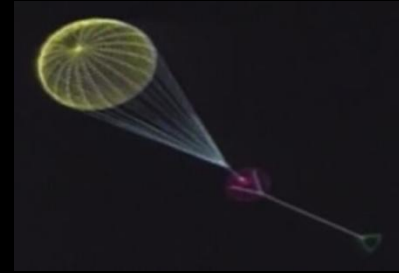
■ 설계



- 정식화 5단계 사용

- 1) Step 1: Project/problem statement.
- 2) Step 2: Data and information collection.
- 3) Step 3: Identification/definition of design variables.
- 4) Step 4: Identification of a criterion to be optimized.
- 5) Step 5: Identification of constraints .

- Step 1

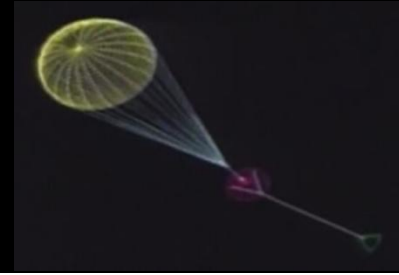


■ Project/problem statement.



목적	스피릿호의 안전한 착륙
공기저항	낙하 속도를 충분히 감소시킬 수 있는 투영면적($(\pi \cdot d^2)/4$)의 설계
강도	소재가 drag force와 gravity를 견딜 수 있는 disk의 직경(d_1)과 두께(t) Suspension line의 직경(d_2) 길이(L)의 설계
질량의 최소화	재료비 감소 우주선 설계의 기본조건

- Step 2



■ Data and information collection.

mars

Density of air	0.013 kg/m^3
gravity	3.72 m/s^2

Parachute

Coefficient of form	1.75
Disk (Nylon 66, Heat Stabilized)	
Tearing strength	82.8 MPa
density	120 kg/m^3
Cable (technora fabric)	
Tensile strength	3000 MPa
density	140 kg/m^3

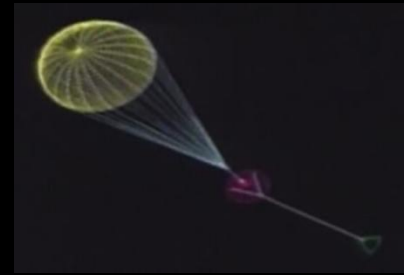
Sprit

mass	900kg
Initial velocity	450m/s
Final velocity	50m/s

(ref)

- ✓ <http://ejectionseat.com.ne.kr/naceshelpk.htm>
(반구형 형상의 공기저항 계수)
- ✓ 보이스 오딧세이 - 저자 : 김형태
<http://www.korearth.net/>
(properties of mars)
- ✓ nasa.gov
- ✓ matweb.com (properties of nylon)

- Step 3

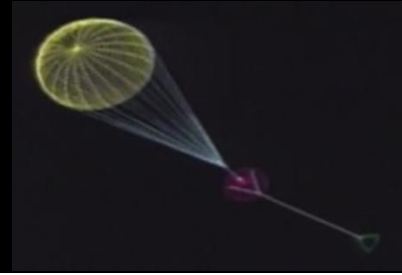


- Identification/definition of design variables.



d_1 : diameter of disk
 t : thickness of disk
 d_2 : diameter of cable
 l : length of cable
 n : number of cable

- Step 4



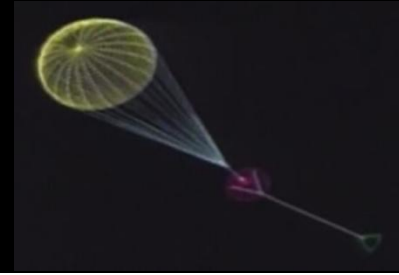
- Identification of a criterion to be optimized.

- minimize weight of parachute

$$f = \frac{1}{2} \rho_{disk} (t * \pi * d1^2) + \frac{1}{4} \rho_{cable} (n * l * \pi * d2^2)$$

$$f = d_{end} * (t * \pi * 0.99 * d1^2) / 2 + d_{enc} * (n * l * \pi * d2^2) / 4$$

- Step 5(1)



■ Identification of constraints .

$g_1 = \sqrt{8 * g * M / (0.013 * c * \pi * d_1.^2)} - v_a$
(resistance of air)

$g_2 = k * \text{denm} * c * v_0.^2 * d_1 / (8 * t) - \text{sigda} \leq 0$
(tearing stress of disk)

$g_3 = k * 4 * M * g * \cos(\arcsin(d_1 / (2 * l))) / (n * \pi * d_2.^2) - \text{sigca} \leq 0$
(tensile strength of cable)

$g_4 = -d_1 \leq 0$

$g_5 = -t \leq 0$

$g_6 = -d_2 \leq 0$

$g_7 = -l \leq 0$

$g_8 = -n \leq 0$

$g_9 = 20t - d_1 \leq 0$

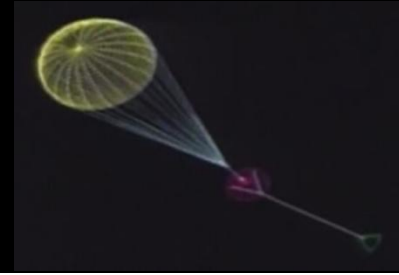
$g_{10} = d_1 - 2l \leq 0$

$g_{11} = n = \text{integer}$

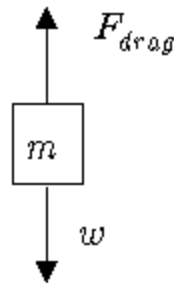
parachute		sprit		Disk(Nylon 66, Heat Stabilized)	
Coefficient of form	c	mass	m	Tearing strength	sigda
mars		Initial velocity	Vo	density	dend
Density of air	denm	Final velocity	va	Cable(technora fabric)	
gravity	g			Tensile strength	sigca
-		-		density	denc

- $M = (m + 0.5 * \text{dend} * \pi * t * d_1.^2 + 0.25 * \text{denc} * n * l * \pi * d_2.^2)$
- $k(\text{safety factor}) = 3$
- $n = 100; l = 48; d_2 = 0.001;$

- Step 5(2)



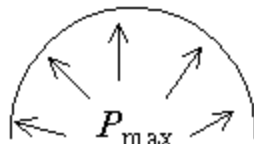
■ g1



$$w = F_{drag}, \quad mg = \frac{1}{2} c \rho_{air} A v^2$$

$$v_{final} = \sqrt{\frac{8mg}{c \rho_{air} \pi d^2}}$$

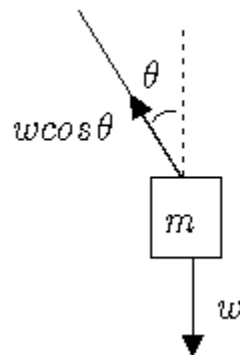
■ g2



$$P_{max} * (\pi * d1^2 / 4) = \sigma_d * (\pi * d1) (t)$$

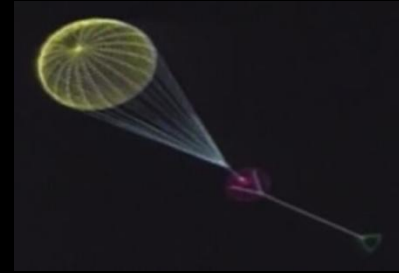
$$\sigma_d = \frac{p d1}{4t} \quad (p_{max} = \frac{1}{2} \rho c v_o^2 \text{ 낙하산이 펴질 때})$$

■ g3



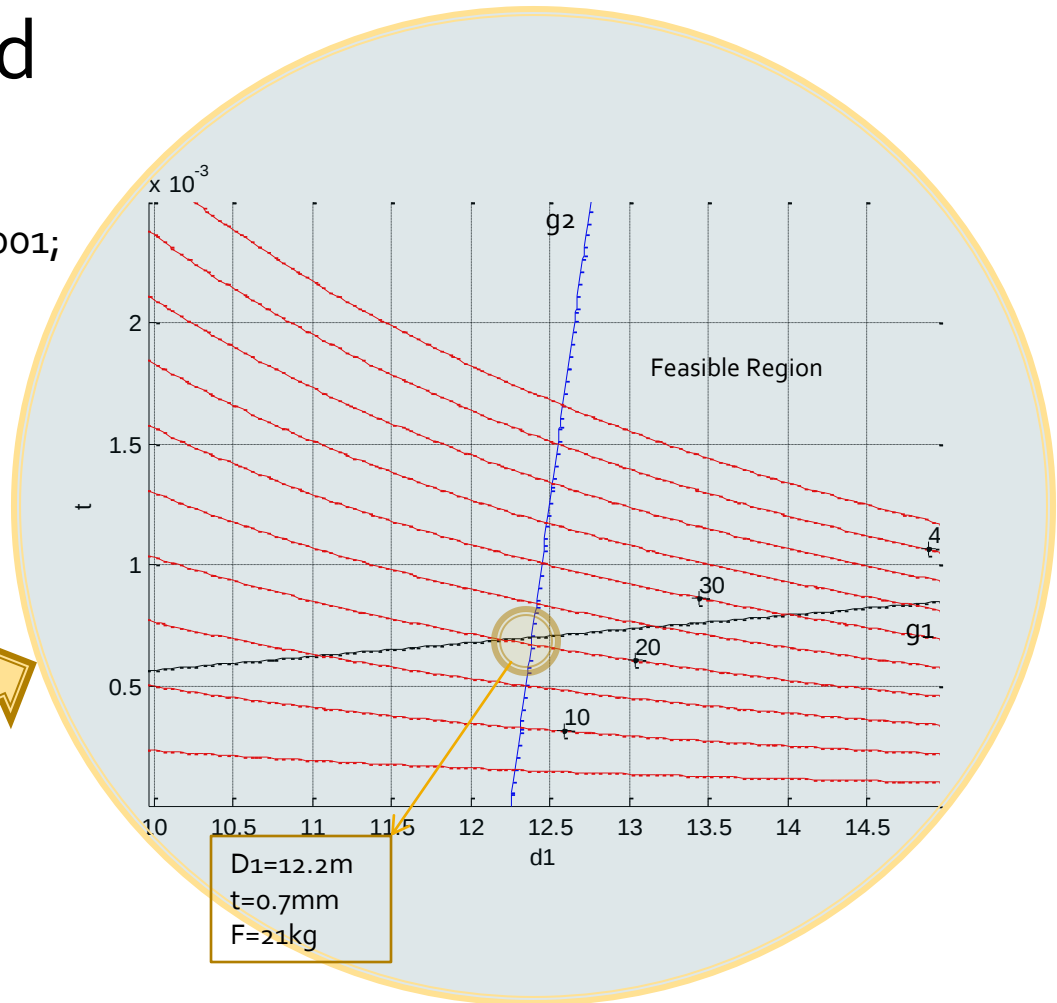
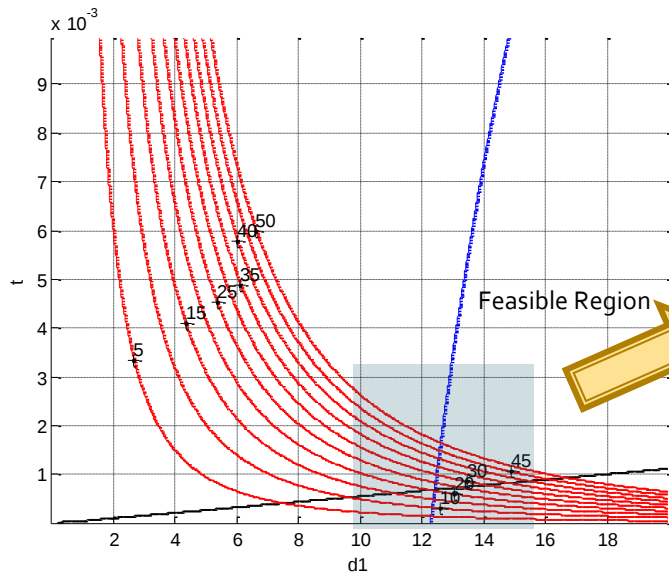
$$\sigma_c = \frac{w \cos \theta}{A_c} = \frac{mg_m \cos \theta}{n \frac{\pi}{4} (d2)^2} \quad (\theta = \sin^{-1} \frac{d1}{2l})$$

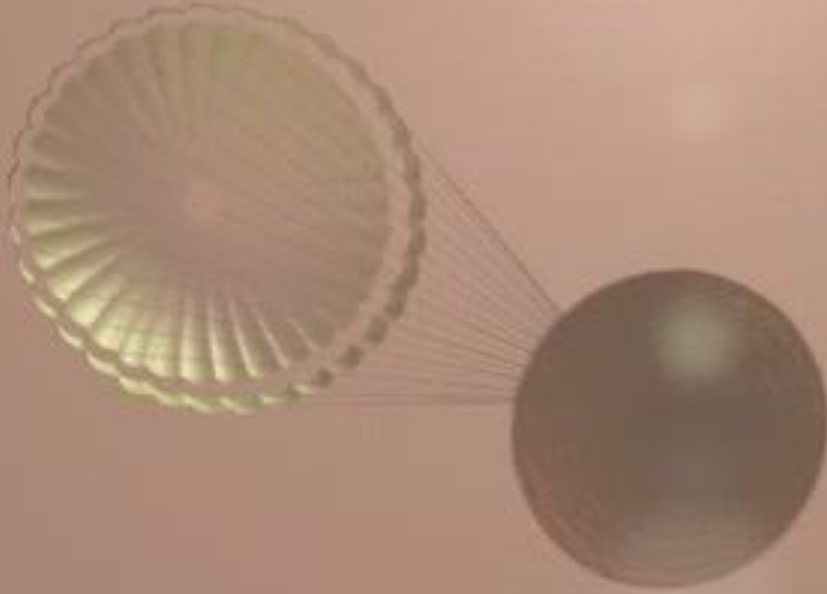
■ 해 찾기



■ Graphical method - Matlab contour

=> $f(d_1, t) : n=100; l=48; d_2=0.001;$





이상으로 AMOLED 조의
발표를 마치겠습니다.

감사합니다.