Introduction of python & combustion instability

2019.12.17

김보연

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Introduction

- Python은 1991년 프로그래머인 귀도 반 로섬(Guido van Rossum)이 발표한 고급 프로그래밍 언어이다.
- 특징
  - 인터프리터 언어, 한번에 한줄씩 실행
  - 무료로 사용가능
  - C, C++, JAVA 등 다른 프로그래밍 언어와 쉽게 통합할 수 있다.
  - 교차 플랫폼 언어, 윈도우, 리눅스 등 다양한 플랫폼에서 쓸 수 있다
  - 빠른개발속도
  - 간결한 코드

```c
#include <stdio.h>
int main(){
    printf("Hello world");
    return 0;
}
```

C

```python
print("Hello  world")
```

Python

Introduction

Feb 2019	Feb 2018	Change	Programming Language	Ratings	Change
1	1		Java	15.876%	+0.89%
2	2		C	12.424%	+0.57%
3	4	^	Python	7.574%	+2.41%
4	3	v	C++	7.444%	+1.72%
5	6	^	Visual Basic .NET	7.095%	+3.02%
6	8	^	JavaScript	2.848%	-0.32%
7	5	v	C#	2.846%	-1.61%
8	7	v	PHP	2.271%	-1.15%
9	11	^	SQL	1.900%	-0.46%
10	20	^^	Objective-C	1.447%	+0.32%
11	15	^^	Assembly language	1.377%	-0.46%
12	19	^^	MATLAB	1.196%	-0.03%
13	17	^^	Perl	1.102%	-0.66%
14	9	vv	Delphi/Object Pascal	1.066%	-1.52%
15	13	v	R	1.043%	-1.04%
16	10	vv	Ruby	1.037%	-1.50%
17	12	vv	Visual Basic	0.991%	-1.19%
18	18		Go	0.960%	-0.46%
19	49	^^	Groovy	0.936%	+0.75%
20	16	vv	Swift	0.918%	-0.88%

- 파이썬은 많은 제품이나 기업 및 연구기관에서 쓰이고 있다. 대표적인 예는 다음과 같다.
- **파이썬으로 작성된 자유-오픈 소스 소프트웨어**
  - 아나콘다(Anaconda)
  - 비트토렌트(BitTorrent)
  - 장고(웹 프레임워크)
  - 드롭박스(Dropbox)
- **파이썬을 내부적으로 사용하는 소프트웨어**
  - softimage|xsi (3D 애니메이션 소프트웨어)
  - 문명 IV
  - 오토데스크 마야 (3D 애니메이션 소프트웨어)
  - TORRENT(공유 프로그램)
  - 카카오톡(모바일/PC 메신저)
- **파이썬을 이용하고 있는 기업, 정부 기관**
  - 야후
  - 구글
  - 카카오
  - 미국항공우주국(NASA)

Basic grammar

Number

```
# 기본적인 사칙연산
print(5 + 6)   # 11
print(5 - 2)   # 3
print(3 * 8)   # 24
print(3 ** 3)  # 27 제곱
print(8 / 2)   # 4.0 float형
print(8 // 2)  # 4 int형
print(8 % 3)   # 2 나머지
```

String

```
test = "Hello World!"
print(test)  # Hello World!

test = 'Hello!'
print(test)  # Hello!

test = 'I don\'t need Coke!'
print(test)  # I don't need Coke!

test = "I don't need Coke!"
print(test)  # I don't need Coke!

first = 'Myungseo'
last = 'Kang'

print(first + last)  # Myungseo Kang
print(last * 5)      # KangKangKangKangKang
```

Slicing string

```
test_str = 'Leopold'

print(test_str[0])   # L
print(test_str[1])   # e
print(test_str[-1])  # d
print(test_str[-2])  # l

print(test_str[2:5])  # opo
print(test_str[3:6])  # pol
print(test_str[:5])   # Leopo
print(test_str[3:])   # pold
```

Basic grammar

If, elif, else

```
name = 'Leopold'

if name is 'Myungseo':
    print('Hello Myungseo')
elif name is 'Kang':
    print('Hello Kang!')
else:
    print('Hello Everyone!')
```

List

```
a = [] # a = list()와 동일
b = [1, 3, 5]
c = ['Leopold', 'Myungseo', 'Kang', 'L3opold7']
d = [7, 9, ['Myungseo', 'L3opold7']]

print(b[-1])     # 5
print(c[-2])     # Kang
print(d[-1][0])  # Myungseo

# List 값 수정
test = [1, 2, 3, 4, 5]
test[3] = 6

print(test)  # [1, 2, 3, 6, 5]
```

Tuple

```
tp1 = (1, 2, 3)
tp2 = (4, 5, 6)

print(tp1[2])     # 3
print(tp1[1:])    # (2, 3)
print(tp1 + tp2)  # (1, 2, 3, 4, 5, 6)
print(tp2 * 2)    # (4, 5, 6, 4, 5, 6)
```

Basic grammar

Dictionary

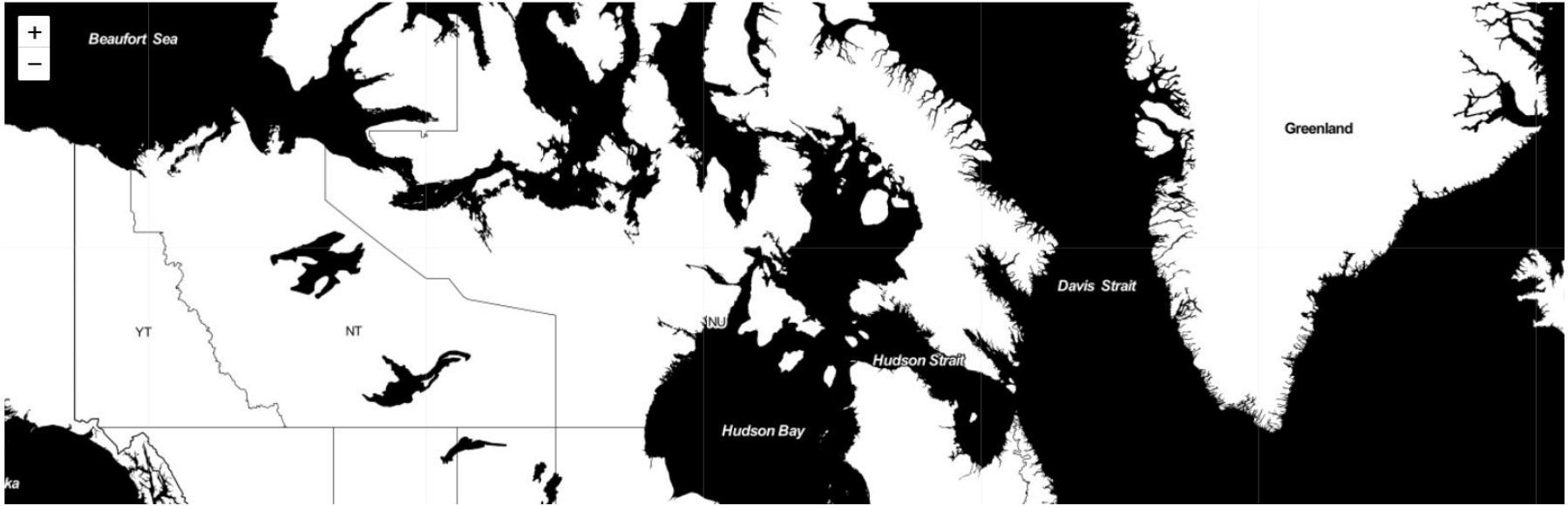
```
dic1 = dict()
dic2 = {'k1': 'v1', 'k2': 'v2', 'k3': 'v3'}
dic3 = dict([('name', 'L3opold7'), ('phone', '010-1234-5678')])
dic4 = dict(firstname='Myungseo', lastname='Kang')
dic5 = {'ls': ['a', 'b', 'c']}

print(dic2)               # {'k1': 'v1', 'k3': 'v3', 'k2': 'v2'}
print(dic2['k2'])         # v2
print(dic3)               # {'phone': '010-1234-5678', 'name': 'L3opold7'}
print(dic3['name'])       # L3opold7
print(dic4)               # {'firstname': 'Myungseo', 'lastname': 'Kang'}
print(dic4['firstname'])  # Myungseo
print(dic5['ls'])         # ['a', 'b', 'c']
```

Set

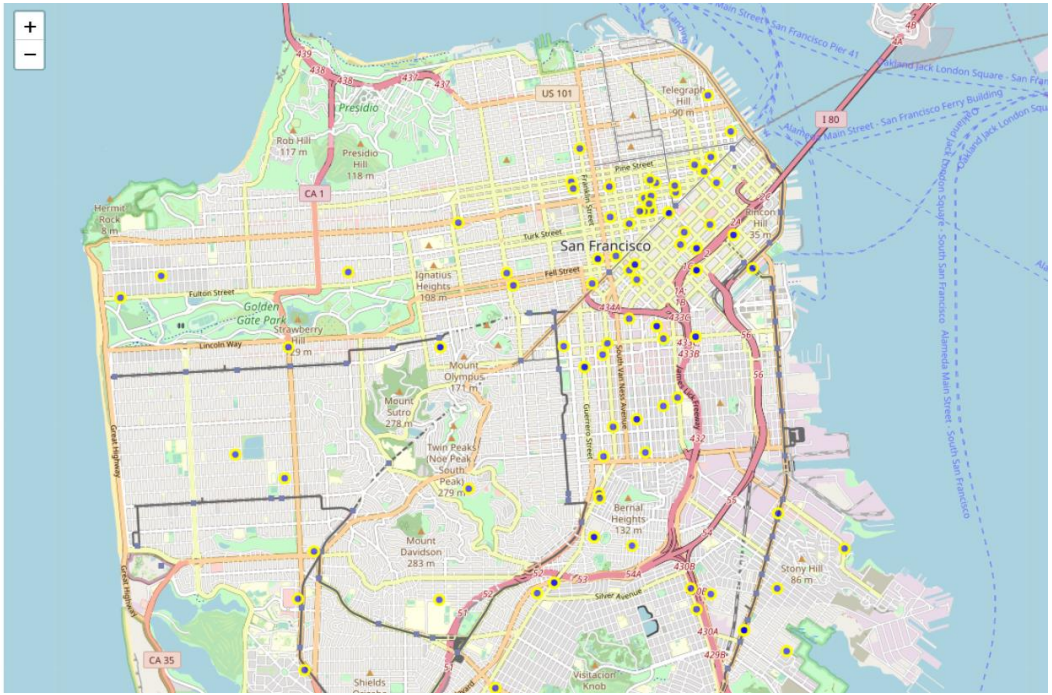
```
s = set([1, 2, 3, 4, 5])
print(s)  # {1, 2, 3, 4, 5}

hello = set('Hello World!')
print(hello)  # {' ', 'H', '!', 'e', 'l', 'o', 'd', 'W', 'r'}

set1 = set([1, 2, 3, 4, 5, 6])
set2 = set([5, 6, 7, 8, 9, 0])

print(set1 & set2)  # {5, 6}
print(set1 | set2)  # {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}
print(set1 - set2)  # {1, 2, 3, 4}
print(set2 - set1)  # {0, 8, 9, 7}
```

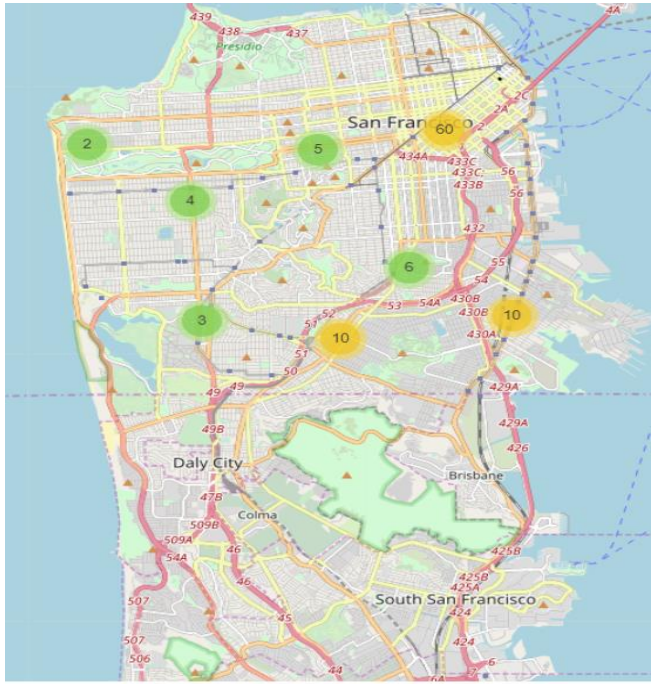
Data visualization

```
[7]  # create a Stamen Toner map of the world centered around Canada
     world_map = folium.Map(location=[56.130, -106.35], zoom_start=4, tiles='Stamen Toner')

     # display map
     world_map
```



Data visualization

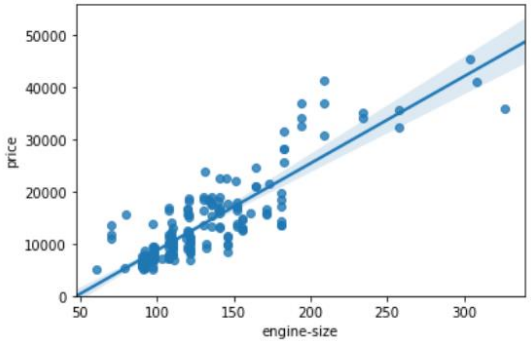




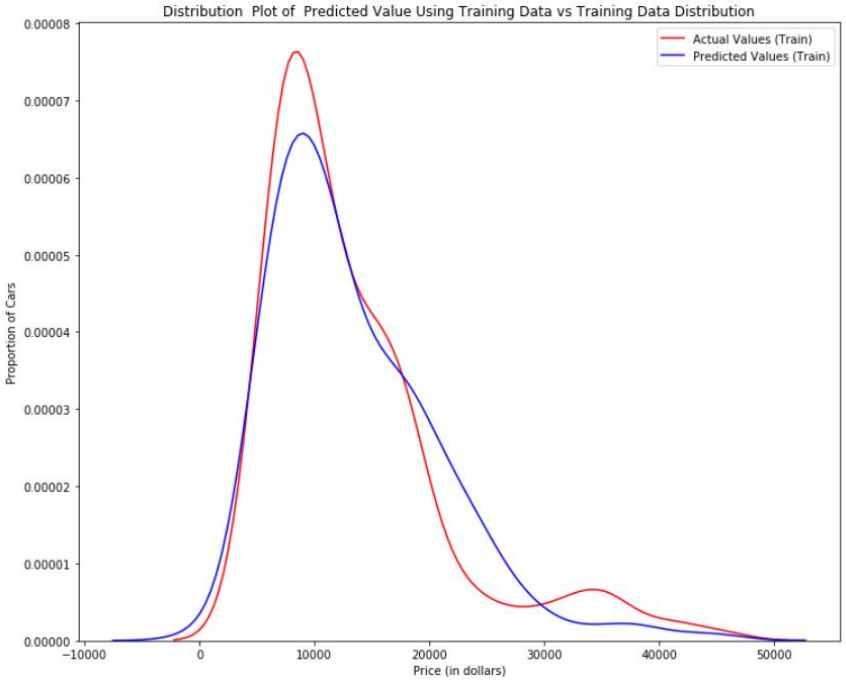
Data analysis

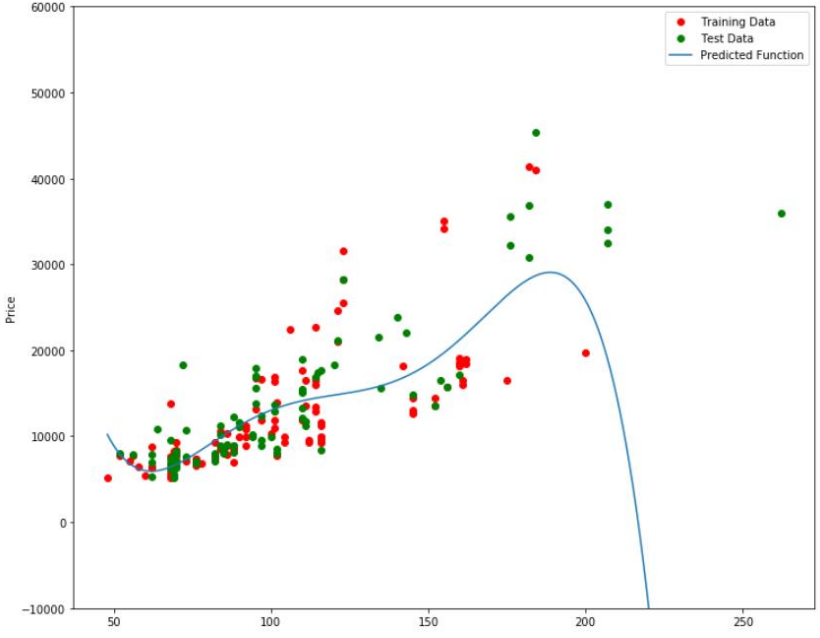
	symboling	normalized-losses	make	aspiration	num-of-doors	body-style	drive-wheels	engine-location	wheel-base	length	...	compression-ratio	horsepower	peak-rpm	city-mpg	highway-mpg	price
0	3	122	alfa-romero	std	two	convertible	rwd	front	88.6	0.811148	...	9.0	111.0	5000.0	21	27	13495.0
1	3	122	alfa-romero	std	two	convertible	rwd	front	88.6	0.811148	...	9.0	111.0	5000.0	21	27	16500.0
2	1	122	alfa-romero	std	two	hatchback	rwd	front	94.5	0.822681	...	9.0	154.0	5000.0	19	26	16500.0
3	2	164	audi	std	four	sedan	fwd	front	99.8	0.848630	...	10.0	102.0	5500.0	24	30	13950.0
4	2	164	audi	std	four	sedan	4wd	front	99.4	0.848630	...	8.0	115.0	5500.0	18	22	17450.0

```
# Engine size as potential predictor variable of price
sns.regplot(x="engine-size", y="price", data=df)
plt.ylim(0,)
```

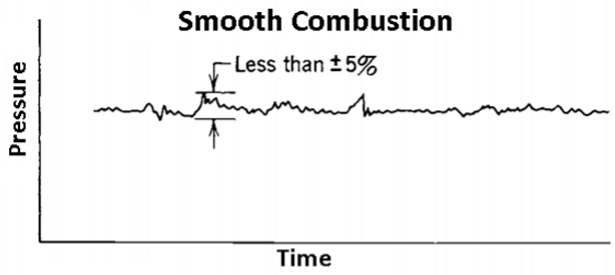


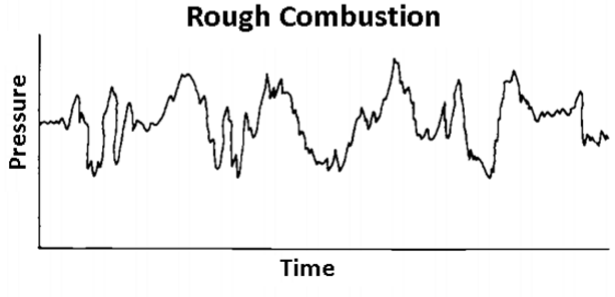
Data analysis

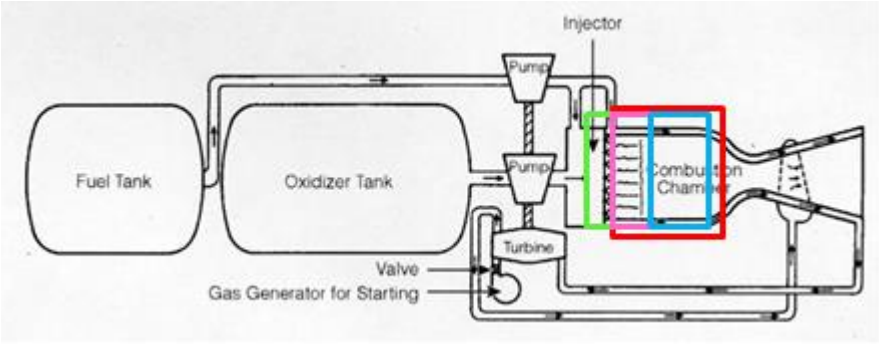


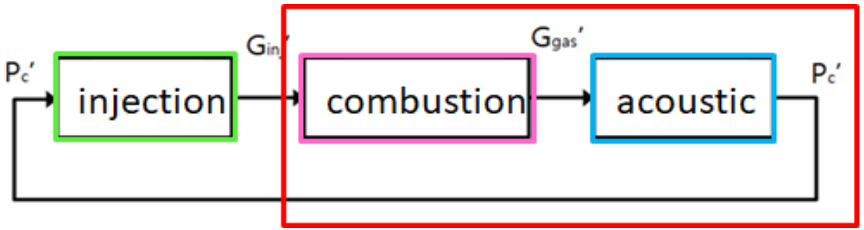


Combustion instability

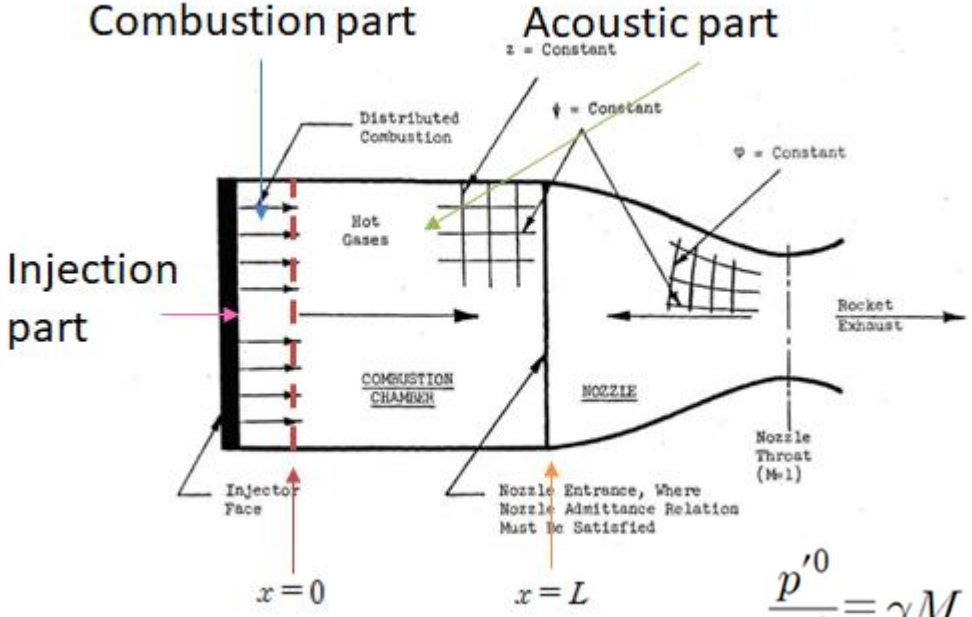








Combustion instability



$$Nozzle\ admittance = A = \frac{G_{gas}'}{p_c'}$$

$$\frac{G_{gas}'}{p'^{o}} = n(1 - e^{-iw\tau})$$

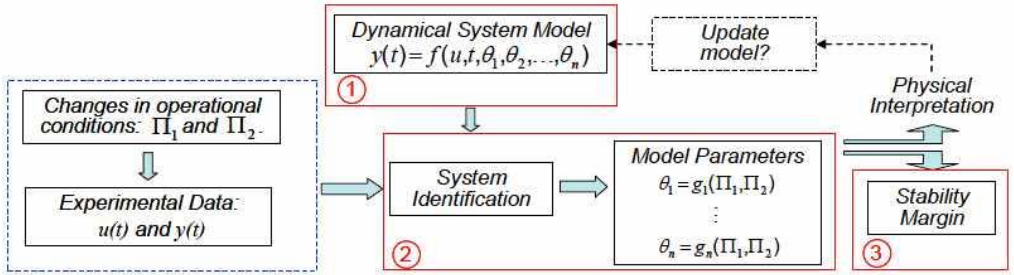
Acoustic Equation Combustion Equation

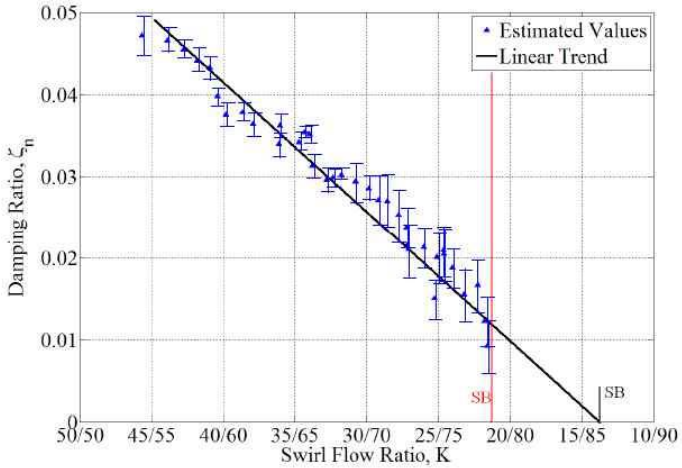
$$p_c' = p'^{o} \ , \quad u_c' = u'^{o} \quad (x = 0)$$

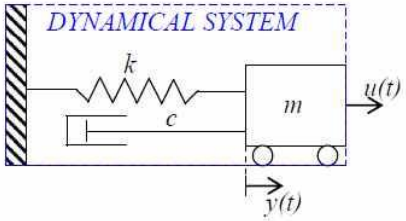
$$u_c' = \frac{\gamma - 1}{2\gamma} p_c' \qquad (x = L)$$

$$\frac{p'^{0}}{u'^{0}} = \gamma M \ \frac{1 - M(1+M)k_{mn}^{0} + B[1 + M(1-M)k_{mn}^{0}]}{1 - M(1+M)k_{mn}^{0} - B[1 + M(1-M)k_{mn}^{0}]}$$

Combustion instability







$$\frac{d^2x}{dt^2}+2\zeta\omega_n\frac{dx}{dt}+\omega_n^2x=0$$

Next plan

- 과거에는 액체로켓엔진 연소불안정 확인을 위해서 수치해석 또는 연소실험을 통한 평가가 많았다.
- 최근 데이터분석을 적용한 연소불안정 해석 연구결과가 도출되고 있다.
- 단기목표 : 데이터분석방법을 연구에 적용하여 수치해석, 연소실험결과와 비교