ISM model

April 17, 2019

0.0.1 ISM mode rene 2017

	10	9	8	7	6	5	4	3	2	1
parameters										
1	V	V	O	V	O	O	V	V	V	NaN
2	V	V	V	V	O	V	V	V	NaN	NaN
3	V	O	V	V	V	V	V	NaN	NaN	NaN
4	V	O	V	A	O	X	NaN	NaN	NaN	NaN
5	V	O	V	V	V	NaN	NaN	NaN	NaN	NaN
6	V	O	V	V	NaN	NaN	NaN	NaN	NaN	NaN
7	V	O	X	NaN	NaN	NaN	NaN	NaN	NaN	NaN
8	V	O	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
9	V	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
10	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

0.1 Initial Reachability Matrix

Out[52]:

	1	2	3	4	5	6	7	8	9	10
1	1	1	1	1	0	0	1	0	1	1
2	0	1	1	1	1	0	1	1	1	1
3	0	0	1	1	1	1	1	1	0	1
4	0	0	0	1	1	0	0	1	0	1
5	0	0	0	1	1	1	1	1	0	1
6	0	0	0	0	0	1	1	1	0	1
7	0	0	0	1	0	0	1	1	0	1
8	0	0	0	0	0	0	1	1	0	1
9	0	0	0	0	0	0	0	0	1	1
10	0	0	0	0	0	0	0	0	0	1

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0.2 Final Reachability Matrix

Out[56]:

	1	2	3	4	5	6	7	8	9	10
1	1	1	1	1	1	1	1	1	1	1
2	0	1	1	1	1	1	1	1	1	1

```
3   0  0  1  1  1  1  1  1  0   1
4   0  0  0  1  1  1  1  1  0   1
5   0  0  0  1  1  1  1  1  0   1
6   0  0  0  1  0  1  1  1  0   1
7   0  0  0  1  1  1  1  1  0   1
8   0  0  0  1  1  1  1  1  0   1
9   0  0  0  0  0  0  0  0  1   1
10  0  0  0  0  0  0  0  0  0   1
```

Out[57]:

	Parameter	Reachability_set	Level	Antecedent_set	Intersection_set
0	1.0	{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}	NaN	{1}	{1}
1	2.0	{2, 3, 4, 5, 6, 7, 8, 9, 10}	NaN	{1, 2}	{2}
2	3.0	{3, 4, 5, 6, 7, 8, 10}	NaN	{1, 2, 3}	{3}
3	4.0	{4, 5, 6, 7, 8, 10}	NaN	{1, 2, 3, 4, 5, 6, 7, 8}	{4, 5, 6, 7, 8}
4	5.0	{4, 5, 6, 7, 8, 10}	NaN	{1, 2, 3, 4, 5, 7, 8}	{8, 4, 5, 7}
5	6.0	{4, 6, 7, 8, 10}	NaN	{1, 2, 3, 4, 5, 6, 7, 8}	{8, 4, 6, 7}
6	7.0	{4, 5, 6, 7, 8, 10}	NaN	{1, 2, 3, 4, 5, 6, 7, 8}	{4, 5, 6, 7, 8}
7	8.0	{4, 5, 6, 7, 8, 10}	NaN	{1, 2, 3, 4, 5, 6, 7, 8}	{4, 5, 6, 7, 8}
8	9.0	{9, 10}	NaN	{1, 2, 9}	{9}
9	10.0	{10}	NaN	{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}	{10}

1 Barrier Level Iteration:

Iteration Number: 1

	Parameter	Reachability_set	Level
0	1.0	{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}	NaN
1	2.0	{2, 3, 4, 5, 6, 7, 8, 9, 10}	NaN
2	3.0	{3, 4, 5, 6, 7, 8, 10}	NaN
3	4.0	{4, 5, 6, 7, 8, 10}	NaN
4	5.0	{4, 5, 6, 7, 8, 10}	NaN
5	6.0	{4, 6, 7, 8, 10}	NaN
6	7.0	{4, 5, 6, 7, 8, 10}	NaN
7	8.0	{4, 5, 6, 7, 8, 10}	NaN
8	9.0	{9, 10}	NaN
9	10.0	{10}	1.0

	Antecedent_set	Intersection_set
0	{1}	{1}
1	{1, 2}	{2}
2	{1, 2, 3}	{3}
3	{1, 2, 3, 4, 5, 6, 7, 8}	{4, 5, 6, 7, 8}
4	{1, 2, 3, 4, 5, 7, 8}	{8, 4, 5, 7}
5	{1, 2, 3, 4, 5, 6, 7, 8}	{8, 4, 6, 7}
6	{1, 2, 3, 4, 5, 6, 7, 8}	{4, 5, 6, 7, 8}
7	{1, 2, 3, 4, 5, 6, 7, 8}	{4, 5, 6, 7, 8}
8	{1, 2, 9}	{9}
9	{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}	{10}

Iteration Number: 2

	Parameter	Reachability_set	Level	Antecedent_set	\
0	1.0	{1, 2, 3, 4, 5, 6, 7, 8, 9}	NaN	{1}	
1	2.0	{2, 3, 4, 5, 6, 7, 8, 9}	NaN	{1, 2}	
2	3.0	{3, 4, 5, 6, 7, 8}	NaN	{1, 2, 3}	
3	4.0	{4, 5, 6, 7, 8}	2.0	{1, 2, 3, 4, 5, 6, 7, 8}	
4	5.0	{4, 5, 6, 7, 8}	NaN	{1, 2, 3, 4, 5, 7, 8}	
5	6.0	{8, 4, 6, 7}	2.0	{1, 2, 3, 4, 5, 6, 7, 8}	
6	7.0	{4, 5, 6, 7, 8}	2.0	{1, 2, 3, 4, 5, 6, 7, 8}	
7	8.0	{4, 5, 6, 7, 8}	2.0	{1, 2, 3, 4, 5, 6, 7, 8}	
8	9.0	{9}	2.0	{1, 2, 9}	

	Intersection_set
0	{1}
1	{2}
2	{3}
3	{4, 5, 6, 7, 8}
4	{8, 4, 5, 7}
5	{8, 4, 6, 7}
6	{4, 5, 6, 7, 8}
7	{4, 5, 6, 7, 8}
8	{9}

Iteration Number: 3

	Parameter	Reachability_set	Level	Antecedent_set	Intersection_set
0	1.0	{1, 2, 3, 5}	NaN	{1}	{1}
1	2.0	{2, 3, 5}	NaN	{1, 2}	{2}
2	3.0	{3, 5}	NaN	{1, 2, 3}	{3}
4	5.0	{5}	3.0	{1, 2, 3, 5}	{5}

Iteration Number: 4

```
   Parameter Reachability_set  Level Antecedent_set Intersection_set
0        1.0        {1, 2, 3}    NaN            {1}              {1}
1        2.0           {2, 3}    NaN         {1, 2}              {2}
2        3.0              {3}    4.0      {1, 2, 3}              {3}
```

Iteration Number: 5

```
   Parameter Reachability_set  Level Antecedent_set Intersection_set
0        1.0           {1, 2}    NaN            {1}              {1}
1        2.0              {2}    5.0         {1, 2}              {2}
```

Iteration Number: 6

```
   Parameter Reachability_set  Level Antecedent_set Intersection_set
0        1.0              {1}    6.0            {1}              {1}
```

Final Barrier Level Iteration

```
   Parameter Reachability_set                   Antecedent_set  \
9       10.0             {10}  {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
3        4.0  {4, 5, 6, 7, 8}         {1, 2, 3, 4, 5, 6, 7, 8}
5        6.0     {8, 4, 6, 7}         {1, 2, 3, 4, 5, 6, 7, 8}
6        7.0  {4, 5, 6, 7, 8}         {1, 2, 3, 4, 5, 6, 7, 8}
7        8.0  {4, 5, 6, 7, 8}         {1, 2, 3, 4, 5, 6, 7, 8}
8        9.0              {9}                       {1, 2, 9}
4        5.0              {5}                    {1, 2, 3, 5}
2        3.0              {3}                       {1, 2, 3}
1        2.0              {2}                          {1, 2}
0        1.0              {1}                             {1}

  Intersection_set  Level
9             {10}    1.0
3  {4, 5, 6, 7, 8}    2.0
5     {8, 4, 6, 7}    2.0
6  {4, 5, 6, 7, 8}    2.0
7  {4, 5, 6, 7, 8}    2.0
8              {9}    2.0
4              {5}    3.0
2              {3}    4.0
1              {2}    5.0
0              {1}    6.0
```

Out[59]:

	10	4	6	7	8	9	5	3	2	1
10	1	0	0	0	0	0	0	0	0	0
4	1	1	1	1	1	0	1	0	0	0

```
6    1  1  1  1  1  0  0  0  0  0
7    1  1  1  1  1  0  1  0  0  0
8    1  1  1  1  1  0  1  0  0  0
9    1  0  0  0  0  1  0  0  0  0
5    1  1  1  1  1  0  1  0  0  0
3    1  1  1  1  1  0  1  1  0  0
2    1  1  1  1  1  1  1  1  1  0
1    1  1  1  1  1  1  1  1  1  1
```

http://graphviz.org/ http://pygraphviz.github.io/documentation/pygraphviz-1.5/tutorial.html#graphs https://graphviz.readthedocs.io/en/stable/examples.html

```
'ISM.gv.pdf'
```

last step : add driving power at the last to FRM