W = emgr(f,g,s,t,w,pr,nf,ut,us,xs,um,xm,dp)

emgr – Empirical Gramian Framework (Version 5.7)

Mandatory Arguments

f	System Vector Field	(Handle)	**x = f(x,u,p,t)**	i.e.: **f = @(x,u,p,t) A*x+B*u+F*p**
g	Output Functional	(Handle)	**y = g(x,u,p,t)**	i.e.: **g = @(x,u,p,t) C*x+D*u**
		1	**y = x**	
s	System Dimensions	(Vector)	**s = [M,N,Q]**	(Inputs, States, Outputs)
t	Time Discretization	(Vector)	**t = [dt,Tf]**	(Time Step, Time Horizon)
w	Gramian Type	(Char)	Empirical System Gramian Type	
		'c'	Empirical Controllability Gramian (returns $\mathbf{W_c}$)	
		'o'	Empirical Observability Gramian (returns $\mathbf{W_o}$)	
		'x'	Empirical Cross Gramian (returns $\mathbf{W_x}$)	
		'y'	Empirical Linear Cross Gramian (returns $\mathbf{W_Y}$)	
		's'	Empirical Sensitivity Gramian (returns $\mathbf{W_c}$, $\mathbf{W_s}$)	
		'i'	Empirical Identifiability Gramian (returns $\mathbf{W_o}$, $\mathbf{W_I}$)	
		'j'	Empirical Joint Gramian (returns $\mathbf{W_x}$, $\mathbf{W_J}$)	

Optional Arguments

pr	Parameters	(Vector)	Column vector of parameters (default: **pr = 0**)
		(Matrix)	Set of parameter columns ($\mathbf{W_s}$, $\mathbf{W_I}$, $\mathbf{W_J}$ require min / max)
nf	Options Flags	(Vector)	Twelve components (default: **nf = 0**)
ut	Input Function	(Handle)	Input function **u_t = ut(t)** or char (default: **ut = 'i'**)
		'i'	Delta impulse (default)
		's'	Step input
		'c'	Decaying exponential chirp
		'r'	Pseudo-random binary
us	Steady-State Input	(Scalar)	Uniform steady-state input (default: **us = 0**)
		(Vector)	Individual steady-state input (**M x 1**)
xs	Steady-State	(Scalar)	Uniform steady-state (default: **xs = 0**)
		(Vector)	Individual steady-states (**N x 1**)
um	Input Scales	(Scalar)	Uniform max input scales (default: **um = 1**)
		(Vector)	Individual max input scales (**M x 1**)
		(Matrix)	Custom input scales (**M x ***)
xm	Steady-State Scales	(Scalar)	Uniform max steady-state scales (default: **xm = 1**)
		(Vector)	Individual max steady-state scales (**N x 1**)
		(Matrix)	Custom steady-state scales (**N x ***)
dp	Dot Product	(Handle)	Handle to custom inner product **xy = dp(x,y)**
		[]	Default matrix product

Option Flags

nf(1)	Trajectory centering	
	0	None (default)
	1	Initial state
	2	Final steady-state
	3	Arithmetic average
	4	Root-mean-squared
	5	Midrange
	6	Geometric mean
nf(2)	Input scale sequence	
	0	Single (default)
	1	Linear
	2	Geometric
	3	Logarithmic
	4	Sparse
nf(3)	State scale sequence	
	0	Single (default)
	1	Linear
	2	Geometric
	3	Logarithmic
	4	Sparse
nf(4)	Input transformation	
	0	± Unit (default)
	1	+ Unit
nf(5)	State transformation	
	0	± Unit (default)
	1	+ Unit
nf(6)	Normalizing	
	0	None (default)
	1	Jacobi
	2	Steady-state
nf(7)	State Gramian Type ($\mathbf{W_o}$, $\mathbf{W_x}$, $\mathbf{W_Y}$, $\mathbf{W_I}$, $\mathbf{W_J}$ only)	
	0	Regular (default)
$\mathbf{W_x}$,$\mathbf{W_Y}$,$\mathbf{W_J}$	**1**	Non-symmetric Cross Gramian
$\mathbf{W_o}$,$\mathbf{W_I}$	**1**	Averaged Observability Gramian
nf(8)	Extra input ($\mathbf{W_o}$, $\mathbf{W_x}$, $\mathbf{W_s}$, $\mathbf{W_I}$, $\mathbf{W_J}$ only)	
	0	No (default)
	1	Yes
nf(9)	Center param. Scales ($\mathbf{W_s}$, $\mathbf{W_I}$, $\mathbf{W_J}$ only)	
	0	No centering (default)
	1	Linear mean centering
	2	Logarithmic mean centering
nf(10)	Parameter Gramian Type ($\mathbf{W_s}$, $\mathbf{W_I}$, $\mathbf{W_J}$ only)	
$\mathbf{W_s}$	**0**	Input-state average (default)
$\mathbf{W_s}$	**1**	Input-output average
$\mathbf{W_I}$,$\mathbf{W_J}$	**0**	Detailed Schur-complement (default)
$\mathbf{W_I}$,$\mathbf{W_J}$	**1**	Approximate Schur-complement
nf(11)	Partitioned cross Gramian ($\mathbf{W_x}$, $\mathbf{W_J}$ only)	
	0	Full cross Gramian
	<N	Cross Gramian partition size
nf(12)	Partitioned cross Gramian ($\mathbf{W_x}$, $\mathbf{W_J}$ only)	
	0	Full cross Gramian
	>0	Partition running index

Custom Solver

Global variable **ODE** to a handle with signature:
y = ODE(f,g,t,x0,u,p) Default: RK – SSP32

Minimal Usage: **W = emgr(f,g,s,t,w)**

About Info: **V = emgr('version')**

More info at: https://gramian.de