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

emgr – Empirical Gramian Framework (Version 5.2)

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	(Vector)	t = [h,T]	(Time Step, Time Horizon)
w	Gramian Type	(Character)		
		'c'	Empirical Controllability Gramian (returns **Wc**)	
		'o'	Empirical Observability Gramian (returns **Wo**)	
		'x'	Empirical Cross Gramian (returns **Wx**)	
		'y'	Empirical Linear Cross Gramian (returns **Wy**)	
		's'	Empirical Sensitivity Gramian (returns **{Wc,Ws}**)	
		'i'	Empirical Identifiability Gramian (returns **{Wo,Wi}**)	
		'j'	Empirical Joint Gramian (returns **{Wx,Wj}**)	

Optional Arguments

pr	Parameters	(Vector)	Column Vector of System Parameters (Default: **pr = 0**)
		(Matrix)	Set of Parameter Column Vectors ('**s**','**i**','**j**' requires two)
nf	Options	(Vector)	Twelve Components (Default: **nf = 0**), see Option Flags
ut	Input Function	(Handle)	Input function **u = ut(t)** (Default: **ut = 1**)
		1	Delta Impulse Input
		∞	Linear Chirp Function
us	Steady-State Input	(Scalar)	Uniform Steady-State Input (Default: **us = 0**)
		(Vector)	Individual Steady-State Input (**J x 1**)
xs	Steady State	(Scalar)	Uniform Steady State (**Default: xs = 0**)
		(Vector)	Individual Steady States (**N x 1**)
um	Input Scales	(Scalar)	Uniform Maximum Input Scales (Default: **um = 1**)
		(Vector)	Individual Maximum Input Scales (**J x 1**)
		(Matrix)	Custom Input Scales (**J x ***)
xm	Steady-State Scales	(Scalar)	Uniform Maximum Steady-State Scales (Default: **xm = 1**)
		(Vector)	Individual Maximum Steady-State Scales (**N x 1**)
		(Matrix)	Custom Steady-State Scales (**N x ***)
dp	Dot Product	(Handle)	Handle to custom inner product **z = dp(x,y)**
		1	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
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	Inverse
nf(5)	State Transformation	
	0	Unit (Default)
	1	Inverse
nf(6)	Preconditioning	
	0	None (Default)
	1	Jacobi (Double Run)
	2	Steady-State Scaled
nf(7)	Non-Symmetric Cross Gramian **(Wx,Wy,Wj only)**	
	0	Off (Default)
	1	Non-Sym. Cross Gramian
nf(8)	Extra Input	
	0	No Extra Input (Default)
	1	Parameter Perturbation Only
nf(9)	Center Param. Scales **(Ws,Wi,Wj only)**	
	0	No Centering
	1	Arithmetic Mean Centering
	2	Logarithmic Mean Centering
nf(10)	Schur complement Options **(WI,WJ only)**	
	0	Detailed Schur-Complement (Default)
	1	Approximate Schur-Complement
nf(11)	Partitioned cross Gramian **(Wx,Wj only)**	
	0	Full cross Gramian
	<N	Cross Gramian Partition Size
nf(12)	Partitioned cross Gramian **(Wx,Wj only)**	
	0	Full cross Gramian
	>0	Partition running index

Custom Solver

Global variable **ODE** to handle with signature:

y = solver(f,g,t,x,u,p); Default: RK – SSP32

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

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

More info at: http://gramian.de