Activités scientifiques à l'ENSIETA

Luc Jaulin,

ElAuto, DTN, ENSIETA

Mercredi 28 avril 2009.

1 Historique

1994-2004 Maître de conférence à Angers. Enseignement : physique et automatique. Recherche : calcul par intervalles.

2004-2009. Professeur à l'ENSIETA. Enseignement : automatique et robotique. Recherche : calcul par intervalles et robotique.

Encadrement de thèse

P. Herrero (cotutelle Espagne). 2003-2006. Calcul par intervalles modal.

S. Bazeille (avec I. Quidu). 2004-08. Vision sous-marine.

G. Soares (cotutelle Brésil). 2004-08. Optimisation multi-objectif.

A. Mazeika (avec C. Osswald). 2005-20??. Fusion multi-radar.

F. Le Bars. SLAM ensembliste (en cours).

J. Sliwka. SLAM ensembliste (en cours).

2 Responsabilités scientifiques

Groupe de travail MEA du GDR MACS (370 personnes)

SWIM-08-09.

Comité de direction du GDR MACS (3000 personnes)

Editeur associé JESA.

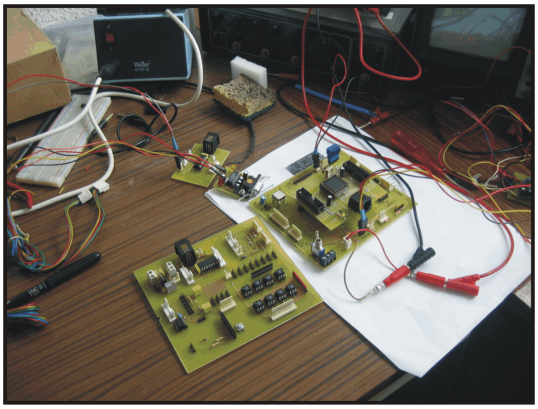
3 Robotique à l'ENSIETA

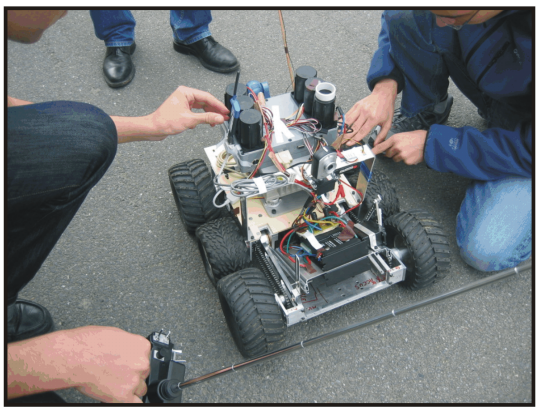
Association pour la promotion de la robotique à l'ENSIETA

ETAS (2005-2008).

SAUCE (2007-2009).

Robot voilier (avec Ecole Navale).



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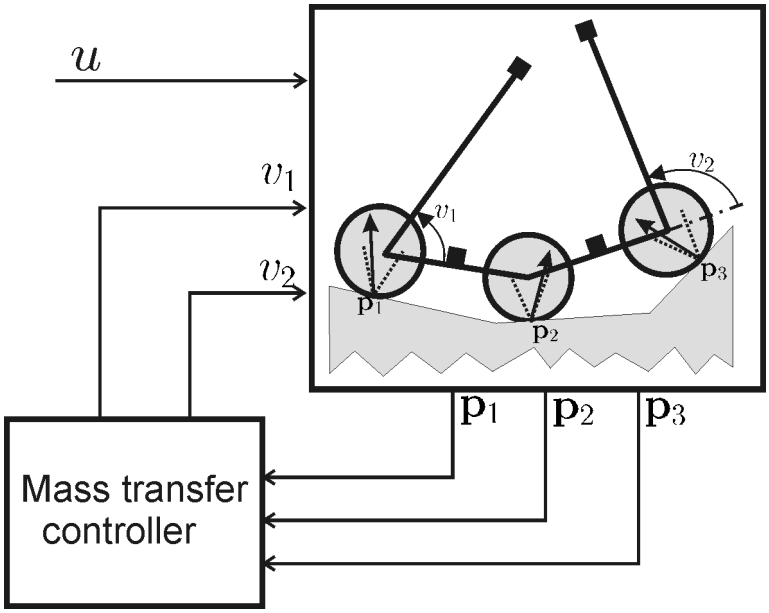
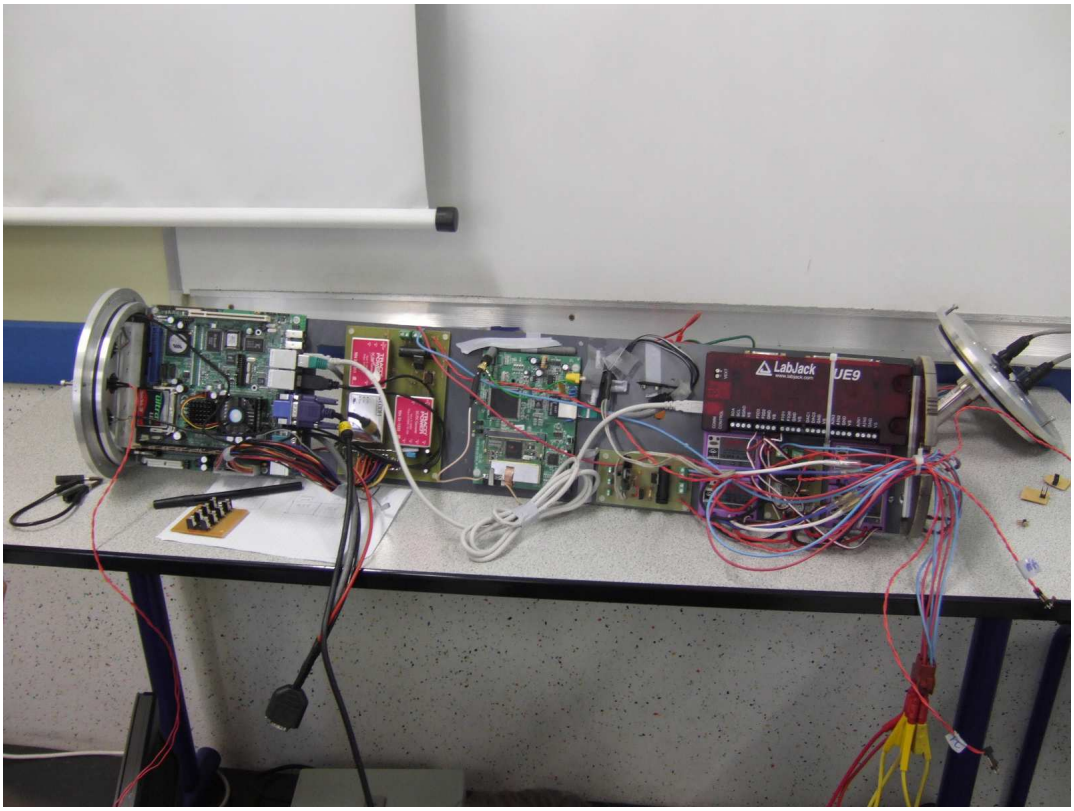
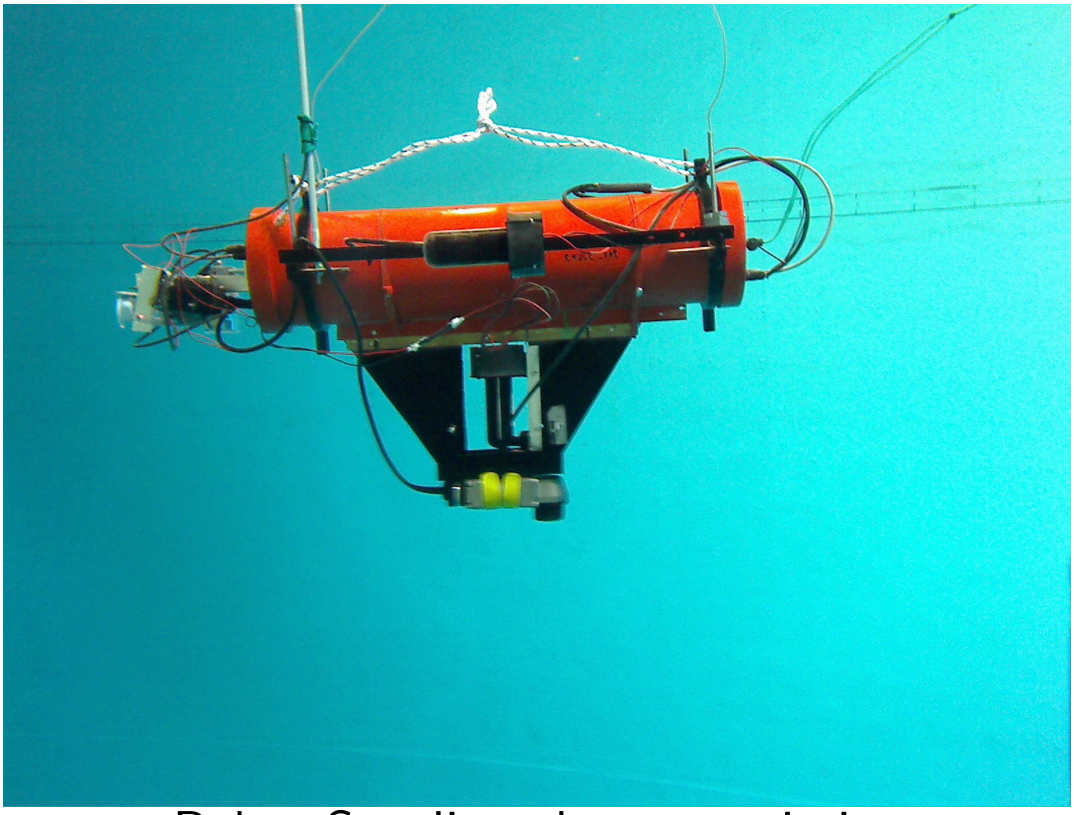
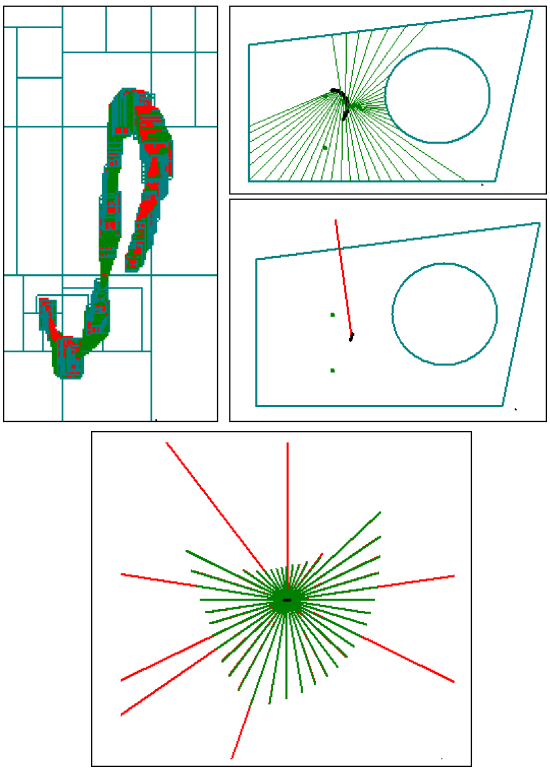

u
v1
v2
v1
v2
p1
p2
p3
p1
p2
p3
Mass transfer
controller

Portsmouth, July 12-15, 2007.


LabJack
UE9



Robot Sauc'isse dans une piscine



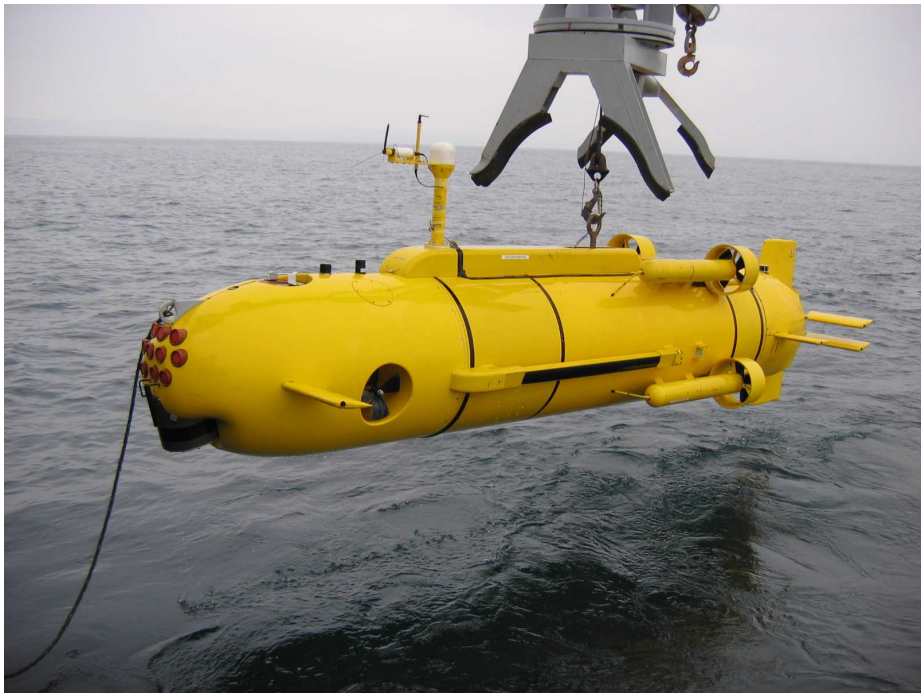
4 Contrats

GESMA (75.000 euros)

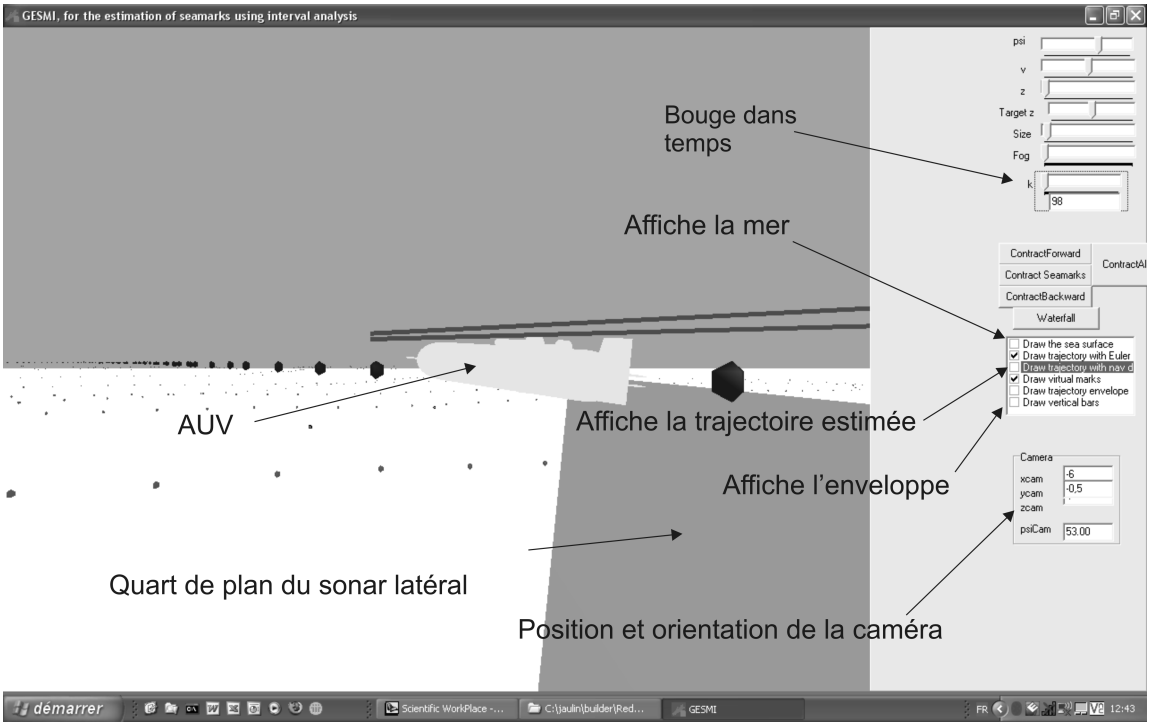
SAUCE, MRIS, (15.000 euros $\times$ 3ans).

ANR Carotte ??

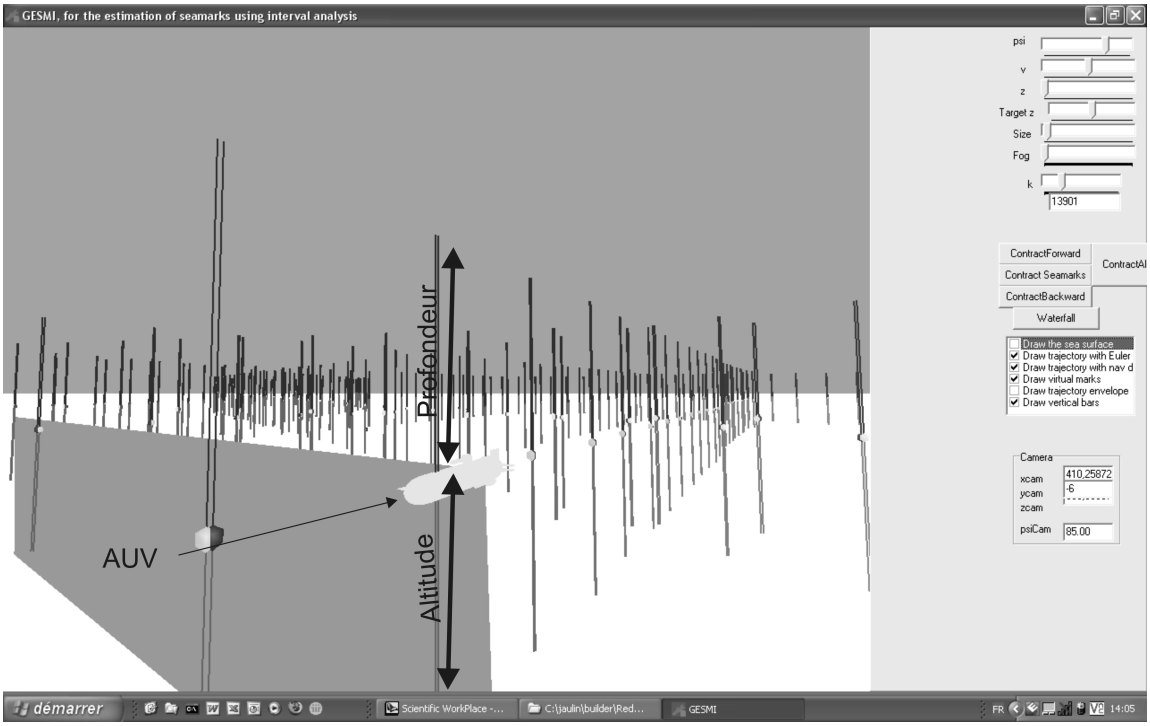
4.1 GESMI



Le *Redermor*, fabriqué par le GESMA
(Groupe d'Etude Sous-Marine de l'Atlantique)


GESMI, for the estimation of seamarks using interval analysis
Bouge dans temps
Affiche la mer
AUV
Affiche la trajectoire estimée
Affiche l'enveloppe
Quart de plan du sonar latéral
Position et orientation de la caméra
psi
v
z
Target z
Size
Fog
k
98
ContractForward
Contract Seamarks
ContractBackward
Waterfall
Draw the sea surface
Draw trajectory with Euler
Draw trajectory with nav.d
Draw virtual marks
Draw trajectory envelope
Draw vertical bars
Camera
xcam
-6
ycam
-0,5
zcam
psiCam
53.00
démarrer
Scientific WorkPlace -...
C:\jaulin\builder\Red...
GESMI
FR
12:43

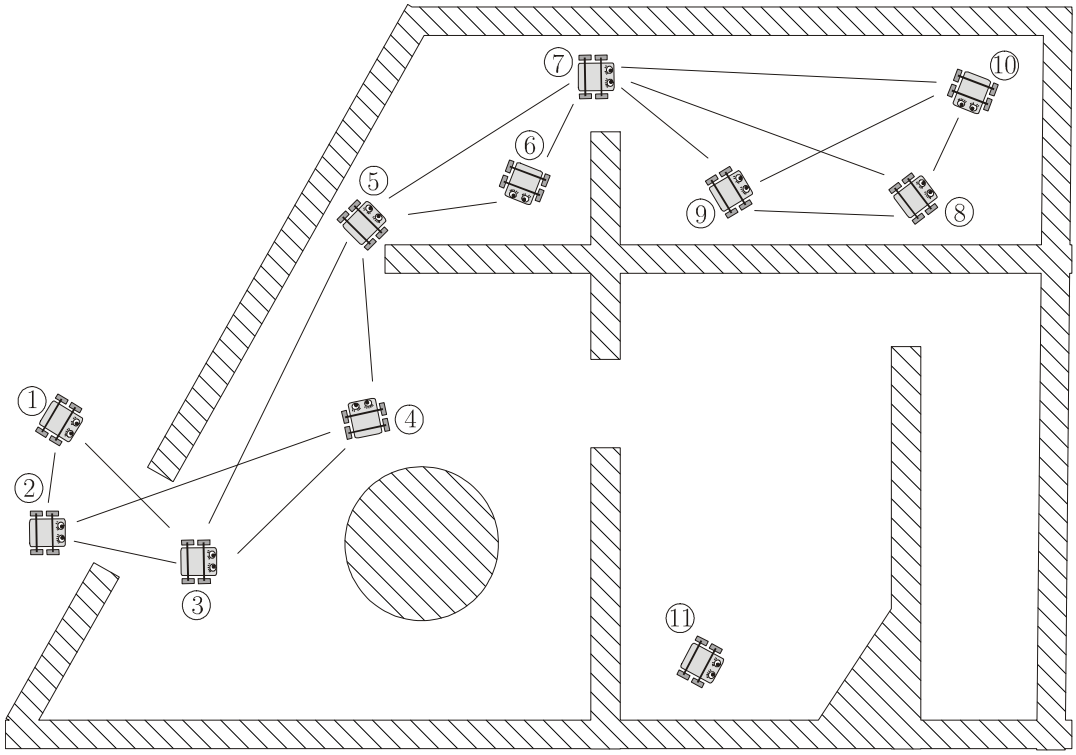
```
% This file has been generated by a generator
% and will be used by GESMI to solve a SLAM problem
% Note : every line starting by a '%' is considered as a comment by GESMI.
% ------------------------------------------------
%
% This file contains
% 1) Some basic information about the scope of the sonar and the sampling time
% 2) The prior domains for the seamarks
% 3) The coordinates for some virtual marks
% 4) sensor data (angles, speeds, depth, altitude, position) with bounds
% 5) ping table : at the end of this file
%
% ------------------------------------------------
% maximal distance of the lateral sonar and error error interval [min,max]
  75.0    1.0
% Sampling time
0.1
% ------------------------------------------------
% Domain for seamarks detected using the software SonarPro
% ------------------------------------------------
%  Initial domains for the mines
% xmin   xmax    ymin     ymax    zmin   zmax
-10000   10000  -10000   10000     0      100
-10000   10000  -10000   10000     0      100
-10000   10000  -10000   10000     0      100
-10000   10000  -10000   10000     0      100
-10000   10000  -10000   10000     0      100
-10000   10000  -10000   10000     0      100
$
%------------------------------------------------
% Virtual marks (only for graphism, not used for computation)
%------------------------------------------------
% x              y             z     colorRed   ColorGreen   ColorBlue  LocalFrame
594.0533723     374.7293035     19       0.1         0         0        0      % seamark 0
599.6093723     484.5528643     19       0.1       0.1         0        0      % seamark 1
601.4613723     557.3573086     19       0.1         0       0.1        0      % seamark 2
94.01337232     -2.868189501    19         0       0.1         0        0      % seamark 3
119.9413723     84.75155672     20         0         0       0.1        0      % seamark 4
127.3493723     156.3280366     20         0         0         0        0      % seamark 5
0               0          0      1      0        0     1    % origin of the local frame
689.96          264.10     0      0      0        1     1    % final GPS
$
%------------------------------------------------
%------------------------------------------------
%t        phi        dphi        theta      dtheta         psi       dpsi        vx       dvx
0     -0.011505     0.0001745329252     0.033556     0.0001745329252     0.415613     0.0052679
0.1     -0.012272     0.0001745329252     0.034994     0.0001745329252     0.416284     0.00526
0.2     -0.012847     0.0001745329252     0.037583     0.0001745329252     0.417051     0.00526
0.3     -0.013422     0.0001745329252     0.040938     0.0001745329252     0.418202     0.00526
0.4     -0.014093     0.0001745329252     0.044773     0.0001745329252     0.419831     0.00526
0.5     -0.014285     0.0001745329252     0.0488     0.0001745329252     0.422228     0.0052679
0.6     -0.013998     0.0001745329252     0.052539     0.0001745329252     0.425488     0.00526
0.7     -0.012943     0.0001745329252     0.055703     0.0001745329252     0.42961     0.005267
0.8     -0.011121     0.0001745329252     0.0581     0.0001745329252     0.434308     0.0052679
0.9     -0.008725     0.0001745329252     0.059825     0.0001745329252     0.439773     0.00526
1     -0.005944     0.0001745329252     0.060496     0.0001745329252     0.445334     0.0052679
1.1     -0.003547     0.0001745329252     0.0604     0.0001745329252     0.450511     0.0052679
1.2     -0.001917     0.0001745329252     0.059729     0.0001745329252     0.455017     0.00526
1.3     -0.001438     0.0001745329252     0.058867     0.0001745329252     0.458564     0.00526
1.4     -0.002013     0.0001745329252     0.058387     0.0001745329252     0.461057     0.00526
1.5     -0.003356     0.0001745329252     0.058483     0.0001745329252     0.462303     0.00526
1.6     -0.005561     0.0001745329252     0.059346     0.0001745329252     0.462591     0.00526
1.7     -0.007958     0.0001745329252     0.060976     0.0001745329252     0.462112     0.00526
```


GESMI, for the estimation of seamarks using interval analysis
Profondeur
Altitude
AUV
psi
v
z
Target z
Size
Fog
k
13901
ContractForward
Contract Seamarks
ContractBackward
Waterfall
Draw the sea surface
Draw trajectory with Euler
Draw trajectory with nav d
Draw virtual marks
Draw trajectory envelope
Draw vertical bars
Camera
xcam
ycam
zcam
410,25872
-6
psiCam
85,00
démarrer
Scientific WorkPlace -...
C:\jaulin\builder\Red...
GESMI
FR
14:05

4.2 Carotte

(CARtographie par ROboT d'un TErritoire)


ENSIETA
U3


①
②
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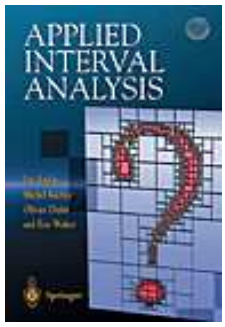
⑪

5 Intervalles



5.1 Calcul par intervalles

Si $\diamond \in \{+, -, ., /, \mathsf{max}, \mathsf{min}\}$

$$[x] \diamond [y] = [\{x \diamond y \mid x \in [x], y \in [y]\}] \,.$$

Par exemple,

$$\begin{aligned} [-1, 3] + [2, 5] &= [1, 8], \\ [-1, 3].[2, 5] &= [-5, 15], \\ [-1, 3]/[2, 5] &= [-\tfrac{1}{2}, \tfrac{3}{2}], \end{aligned}$$

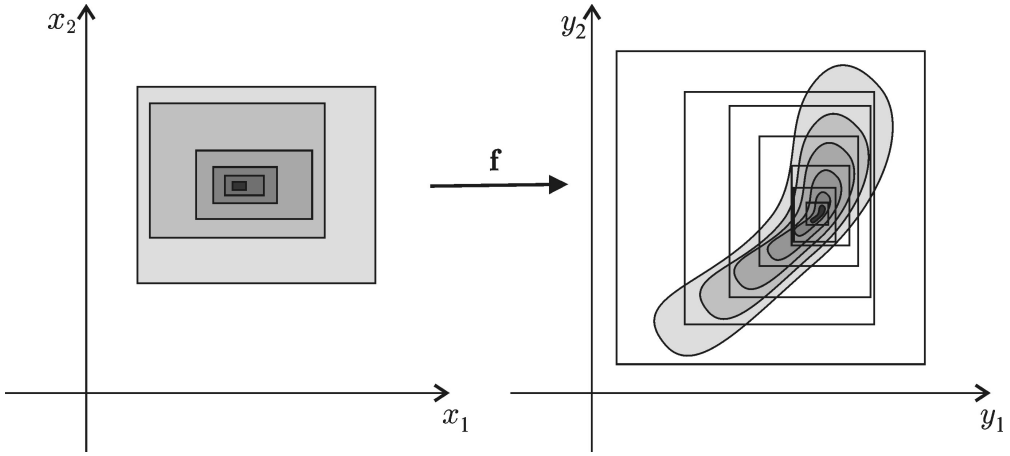
Si $f \in \{\text{cos, sin,sqr, sqrt, log, exp, } \ldots\}$

$$f([x]) = [\{f(x) \mid x \in [x]\}] .$$

Par exemple,

$$\begin{aligned}
\text{sin}([0,\pi]) &= [0,1], \\
\text{sqr}([-1,3]) &= [-1,3]^2 = [0,9], \\
\text{abs}([-7,1]) &= [0,7], \\
\text{sqrt}([-10,4]) &= \sqrt{[-10,4]} = [0,2],
\end{aligned}$$

5.2 Fonction d'inclusion



Fonction d'inclusion convergente et monotone

Exemple : Si $\mathbf{f}$ est donnée par

Algo $\mathbf{f}$(in: $\mathbf{x} = (x_1, x_2, x_3)$, out: $\mathbf{y} = (y_1, y_2)$)
$z := x_1$;
for $k := 0$ to 100
$\quad z := x_2(z + kx_3)$;
next;
$y_1 := z$;
$y_2 := \sin(zx_1)$;

Sa fonction d'inclusion naturelle est

Algo $[\mathbf{f}]$(in: $[\mathbf{x}] = ([x_1], [x_2], [x_3])$, out: $[\mathbf{y}] = ([y_1], [y_2])$)
1 $[z] := [x_1]$;
2 for $k := 0$ to 100
3 $\quad [z] := [x_2] * ([z] + k * [x_3])$;
4 next;
5 $[y_1] := [z]$;
6 $[y_2] := \mathsf{sin}([z] * [x_1])$;

Lancer Setdemo