UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa

Titulació:

Grau en Enginyeria en Tecnologies Industrials

Alumne (nom i cognoms):

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Enunciat TFG / TFM:

Active flow control of the boundary layer on an airfoil: a numerical study

Director/a del TFG / TFM:

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Codirector/a del TFG / TFM:

……

Convocatòria de lliurament del TFG / TFM:

Gener 2021

Annexes

Contingut

A. Introducció

En aquest document, es troben els codis del treball final de grau Active flow control of the boundary layer on an airfoil: a numerical study.

Els codis que es mostren són els codis de GMSH de la geometria de la malla per als dos casos, el cas base i l'actuat.

B. Cas Base

```
blsize=0.01;
wlsize=0.05;
esize=1;
//Punts per definir airfoil
Point(1) = {1, 0, 0, blsize};
Point(2) = {0.999013, 0.000179, 0, blsize};
Point(3) = {0.996057, 0.000715, 0, blsize};
Point(4) = {0.991144, 0.0016, 0, blsize};
Point(5) = {0.9842919999999999, 0.002825, 0, blsize};
Point(6) = {0.975528, 0.004377, 0, blsize};
Point(7) = {0.964888, 0.006237, 0, blsize};
Point(8) = {0.952414, 0.008387, 0, blsize};
Point(9) = {0.938153, 0.010804, 0, blsize};
Point(10) = {0.922164, 0.013463, 0, blsize};
Point(11) = {0.904508, 0.016339, 0, blsize};
Point(12) = {0.885257, 0.019404, 0, blsize};
Point(13) = {0.864484, 0.022632, 0, blsize};
Point(14) = {0.842274, 0.025994, 0, blsize};
Point(15) = {0.818712, 0.029461, 0, blsize};
Point(16) = {0.793893, 0.033006, 0, blsize};
Point(17) = {0.767913, 0.036598, 0, blsize};
Point(18) = {0.740877, 0.04021, 0, blsize};
Point(19) = {0.71289, 0.04381, 0, blsize};
Point(20) = {0.6840619999999999, 0.04737, 0, blsize};
Point(21) = {0.654508, 0.050858, 0, blsize};
Point(22) = {0.624345, 0.054242, 0, blsize};
Point(23) = {0.593691, 0.05749, 0, blsize};
Point(24) = {0.562667, 0.060568, 0, blsize};
Point(25) = {0.531395, 0.063442, 0, blsize};
Point(26) = {0.5, 0.066077, 0, blsize};
Point(27) = {0.468605, 0.068437, 0, blsize};
Point(28) = {0.437333, 0.07048699999999999, 0, blsize};
Point(29) = {0.406309, 0.07219299999999999, 0, blsize};
```

```
Point(30) = {0.375655, 0.07352300000000001, 0, blsize};
Point(31) = {0.345492, 0.074446, 0, blsize};
Point(32) = {0.315938, 0.074934, 0, blsize};
Point(33) = {0.28711, 0.074964, 0, blsize};
Point(34) = {0.259123, 0.074517, 0, blsize};
Point(35) = {0.232087, 0.073578, 0, blsize};
Point(36) = {0.206107, 0.07214, 0, blsize};
Point(37) = {0.181288, 0.070199, 0, blsize};
Point(38) = {0.157726, 0.067758, 0, blsize};
Point(39) = {0.135516, 0.064828, 0, blsize};
Point(40) = {0.114743, 0.061422, 0, blsize};
Point(41) = {0.09549199999999999, 0.057561, 0, blsize};
Point(42) = {0.077836, 0.053269, 0, blsize};
Point(43) = {0.061847, 0.048573, 0, blsize};
Point(44) = {0.047586, 0.043504, 0, blsize};
Point(45) = {0.035112, 0.038091, 0, blsize};
Point(46) = {0.024472, 0.032367, 0, blsize};
Point(47) = {0.015708, 0.02636, 0, blsize};
Point(48) = {0.008855999999999999, 0.020098, 0, blsize};
Point(49) = {0.003943, 0.013605, 0, blsize};
Point(50) = {0.000987, 0.006901, 0, blsize};
Point(51) = {0, 0, 0, blsize};
Point(52) = {0.000987, -0.006901, 0, blsize};
Point(53) = {0.003943, -0.013605, 0, blsize};
Point(54) = {0.008855999999999999, -0.020098, 0, blsize};
Point(55) = {0.015708, -0.02636, 0, blsize};
Point(56) = {0.024472, -0.032367, 0, blsize};
Point(57) = {0.035112, -0.038091, 0, blsize};
Point(58) = {0.047586, -0.043504, 0, blsize};
Point(59) = {0.061847, -0.048573, 0, blsize};
Point(60) = {0.077836, -0.053269, 0, blsize};
Point(61) = {0.09549199999999999, -0.057561, 0, blsize};
Point(62) = {0.114743, -0.061422, 0, blsize};
Point(63) = {0.135516, -0.064828, 0, blsize};
Point(64) = {0.157726, -0.067758, 0, blsize};
Point(65) = {0.181288, -0.070199, 0, blsize};
Point(66) = {0.206107, -0.07214, 0, blsize};
Point(67) = {0.232087, -0.073578, 0, blsize};
Point(68) = {0.259123, -0.074517, 0, blsize};
Point(69) = {0.28711, -0.074964, 0, blsize};
Point(70) = {0.315938, -0.074934, 0, blsize};
Point(71) = {0.345492, -0.074446, 0, blsize};
Point(72) = {0.375655, -0.07352300000000001, 0, blsize};
Point(73) = {0.406309, -0.07219299999999999, 0, blsize};
Point(74) = {0.437333, -0.07048699999999999, 0, blsize};
Point(75) = {0.468605, -0.068437, 0, blsize};
Point(76) = {0.5, -0.066077, 0, blsize};
Point(77) = {0.531395, -0.063442, 0, blsize};
```

```
Point(78) = {0.562667, -0.060568, 0, blsize};
Point(79) = {0.593691, -0.05749, 0, blsize};
Point(80) = {0.624345, -0.054242, 0, blsize};
Point(81) = {0.654508, -0.050858, 0, blsize};
Point(82) = {0.6840619999999999, -0.04737, 0, blsize};
Point(83) = {0.71289, -0.04381, 0, blsize};
Point(84) = {0.740877, -0.04021, 0, blsize};
Point(85) = {0.767913, -0.036598, 0, blsize};
Point(86) = {0.793893, -0.033006, 0, blsize};
Point(87) = {0.818712, -0.029461, 0, blsize};
Point(88) = {0.842274, -0.025994, 0, blsize};
Point(89) = {0.864484, -0.022632, 0, blsize};
Point(90) = {0.885257, -0.019404, 0, blsize};
Point(91) = {0.904508, -0.016339, 0, blsize};
Point(92) = {0.922164, -0.013463, 0, blsize};
Point(93) = {0.938153, -0.010804, 0, blsize};
Point(94) = {0.952414, -0.008387, 0, blsize};
Point(95) = {0.964888, -0.006237, 0, blsize};
Point(96) = {0.975528, -0.004377, 0, blsize};
Point(97) = {0.9842919999999999, -0.002825, 0, blsize};
Point(98) = {0.991144, -0.0016, 0, blsize};
Point(99) = {0.996057, -0.000715, 0, blsize};
Point(100) = {0.999013, -0.000179, 0, blsize};

//Punts per definir exterior
Point(103) = {0, 0, 0, esize};
Point(123) = {10, 10, 0, esize};
Point(135) = {10, -10, 0, esize};
Point(136) = {0, 10, 0, esize};
Point(137) = {0, -10, 0, esize};


//Linies per definir airfoil
Spline(1) = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13};
Spline(2) = {13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29};
Spline(3) = {29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44};
Spline(4) = {44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58};
Spline(5) = {58, 59, 60, 61, 62, 63, 64, 65, 66, 67,68, 69, 70, 71, 72, 73};
Spline(6) = {73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89};
Spline(7) = {89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 1};

//Linies per definir exterior
Circle(140)  ={136, 103, 137};
Line(141) =  {136, 123};
Line(142)={123, 135};
Line(143)={135, 137};
Line Loop (144) = {-140, 141, 142, 143};
Line Loop(145) = {1, 2, 3, 4, 5, 6, 7};
```

```
//Punts per definir airfoil exterior

Point(147) = {1.3, 0, 0, wlsize};
Point(148) = {0.88, 0.05, 0, wlsize};
Point(149) = {0.4, 0.11, 0, wlsize};
Point(151) = {-0.13, 0, 0, wlsize};
Point(153) = {0.4, -0.11, 0, wlsize};
Point(154) = {0.88, -0.05, 0, wlsize};
Point(155) = {0.125, -0.115, 0, wlsize};
Point(156) = {0.04, -0.08, 0, wlsize};
Point(158) = {0.04, 0.08, 0, wlsize};
Point(159) = {0.125, 0.115, 0, wlsize};
Point(160) = {0.65, -0.106, 0, wlsize};
Point(161) = {1.01, -0.008, 0, wlsize};
Point(162) = {0.65, 0.106, 0, wlsize};
Point(163) = {1.01, 0.008, 0, wlsize};
Point(164) = {0.94, -0.035, 0, wlsize};
Point(165) = {0.94, 0.035, 0, wlsize};

//Linies per definir airfoil exterior
BSpline(164) = {163, 165, 148};
BSpline(165) = {148, 162, 149};
BSpline(166) = {149, 159, 158};
BSpline(167) = {158, 151, 156};
BSpline(168) = {156, 155, 153};
BSpline(169) = {153, 160, 154};
BSpline(170) = {154, 164, 161};
Line(171) = {161, 1};
Line(172) = {1, 163};
Line(173) = {148, 13};
Line(174) = {149, 29};
Line(175) = {158, 44};
Line(176) = {156, 58};
Line(177) = {153, 73};
Line(178) = {154, 89};

//Definicio de superficies

Line Loop(179) = {172, 164, 173, -1};
Line Loop(180) = {-173, 165, 174, -2};
Line Loop(181) = {-174, 166, 175, -3};
Line Loop(182) = {-175, 167, 176, -4};
Line Loop(183) = {-176, 168, 177, -5};
Line Loop(184) = {-177, 169, 178, -6};
Line Loop(185) = {-178, 170, 171, -7};
Plane Surface(1) = {179};
```

```
Plane Surface(2) = {180};
Plane Surface(3) = {181};
Plane Surface(4) = {182};
Plane Surface(5) = {183};
Plane Surface(6) = {184};
Plane Surface(7) = {185};
Line Loop(186) = {172, 164, 165, 166, 167, 168, 169, 170, 171};
Plane Surface(187) = {144, 186};

//Transfinite lines
nhor= 100;
nver= 50;
//Horitzontals
Transfinite Line {1} = nhor Using Progression 1;
Transfinite Line {2} = nhor Using Progression 1;
Transfinite Line {3} = nhor Using Progression 1;
Transfinite Line {4} = nhor Using Progression 1;
Transfinite Line {5} = nhor Using Progression 1;
Transfinite Line {6} = nhor Using Progression 1;
Transfinite Line {7} = nhor Using Progression 1;

Transfinite Line {164} = nhor Using Progression 1;
Transfinite Line {165} = nhor Using Progression 1;
Transfinite Line {166} = nhor Using Progression 1;
Transfinite Line {167} = nhor Using Progression 1;
Transfinite Line {168} = nhor Using Progression 1;
Transfinite Line {169} = nhor Using Progression 1;
Transfinite Line {170} = nhor Using Progression 1;
//Verticals
Transfinite Line {-171} = nver Using Progression 1.1;
Transfinite Line {172} = nver Using Progression 1.1;
Transfinite Line {-173} = nver Using Progression 1.1;
Transfinite Line {-174} = nver Using Progression 1.1;
Transfinite Line {-175} = nver Using Progression 1.1;
Transfinite Line {-176} = nver Using Progression 1.1;
Transfinite Line {-177} = nver Using Progression 1.1;
Transfinite Line {-178} = nver Using Progression 1.1;


//Tractament de superficies
Transfinite Surface {1};
Transfinite Surface {2};
Transfinite Surface {3};
Transfinite Surface {4};
Transfinite Surface {5};
Transfinite Surface {6};
Transfinite Surface {7};
```

```
Recombine Surface {1};
Recombine Surface {2};
Recombine Surface {3};
Recombine Surface {4};
Recombine Surface {5};
Recombine Surface {6};
Recombine Surface {7};


Extrude {0, 0, 1}
{
    Surface{1, 2, 3, 4, 5, 6, 7, 187};
    Layers{1};
    Recombine;
}

Physical Surface("airfoil") = {252, 230, 208, 340, 318, 296, 274};
Physical Surface("inlet") = {359};
Physical Surface("outlet") = {367, 363, 371};
Physical Surface("frontAndBack") = {408, 187, 275, 297, 319, 341, 253, 231, 209, 1, 2, 3,
4, 5, 6, 7};
Physical Volume("fluid") = {1, 2, 3, 4, 5, 6, 7, 8};
```

C. Cas actuador

```
blsize=0.01;
wlsize=0.05;
esize=1;
//Punts per definir airfoil
Point(1) = {1, 0, 0, blsize};
Point(2) = {0.999013, 0.000179, 0, blsize};
Point(3) = {0.996057, 0.000715, 0, blsize};
Point(4) = {0.991144, 0.0016, 0, blsize};
Point(5) = {0.9842919999999999, 0.002825, 0, blsize};
Point(6) = {0.975528, 0.004377, 0, blsize};
Point(7) = {0.964888, 0.006237, 0, blsize};
Point(8) = {0.952414, 0.008387, 0, blsize};
Point(9) = {0.938153, 0.010804, 0, blsize};
Point(10) = {0.922164, 0.013463, 0, blsize};
Point(11) = {0.904508, 0.016339, 0, blsize};
Point(12) = {0.885257, 0.019404, 0, blsize};
Point(13) = {0.864484, 0.022632, 0, blsize};
Point(14) = {0.842274, 0.025994, 0, blsize};
Point(15) = {0.818712, 0.029461, 0, blsize};
Point(16) = {0.793893, 0.033006, 0, blsize};
Point(17) = {0.767913, 0.036598, 0, blsize};
Point(18) = {0.740877, 0.04021, 0, blsize};
Point(19) = {0.71289, 0.04381, 0, blsize};
Point(20) = {0.6840619999999999, 0.04737, 0, blsize};
Point(21) = {0.654508, 0.050858, 0, blsize};
Point(22) = {0.624345, 0.054242, 0, blsize};
Point(23) = {0.593691, 0.05749, 0, blsize};
Point(24) = {0.562667, 0.060568, 0, blsize};
Point(25) = {0.531395, 0.063442, 0, blsize};
Point(26) = {0.5, 0.066077, 0, blsize};
Point(27) = {0.468605, 0.068437, 0, blsize};
Point(28) = {0.437333, 0.07048699999999999, 0, blsize};
Point(29) = {0.406309, 0.07219299999999999, 0, blsize};
Point(30) = {0.375655, 0.07352300000000001, 0, blsize};
Point(31) = {0.345492, 0.074446, 0, blsize};
Point(32) = {0.315938, 0.074934, 0, blsize};
Point(33) = {0.28711, 0.074964, 0, blsize};
Point(34) = {0.259123, 0.074517, 0, blsize};
Point(35) = {0.232087, 0.073578, 0, blsize};
Point(36) = {0.206107, 0.07214, 0, blsize};
Point(37) = {0.181288, 0.070199, 0, blsize};
```

```
Point(38) = {0.157726, 0.067758, 0, blsize};
Point(167) = {0.14, 0.0655, 0, blsize};
Point(39) = {0.135516, 0.064828, 0, blsize};
Point(166) = {0.12, 0.06232, 0, blsize};
Point(40) = {0.114743, 0.061422, 0, blsize};
Point(41) = {0.09549199999999999, 0.057561, 0, blsize};
Point(42) = {0.077836, 0.053269, 0, blsize};
Point(43) = {0.061847, 0.048573, 0, blsize};
Point(44) = {0.047586, 0.043504, 0, blsize};
Point(45) = {0.035112, 0.038091, 0, blsize};
Point(46) = {0.024472, 0.032367, 0, blsize};
Point(47) = {0.015708, 0.02636, 0, blsize};
Point(48) = {0.008855999999999999, 0.020098, 0, blsize};
Point(49) = {0.003943, 0.013605, 0, blsize};
Point(50) = {0.000987, 0.006901, 0, blsize};
Point(51) = {0, 0, 0, blsize};
Point(52) = {0.000987, -0.006901, 0, blsize};
Point(53) = {0.003943, -0.013605, 0, blsize};
Point(54) = {0.008855999999999999, -0.020098, 0, blsize};
Point(55) = {0.015708, -0.02636, 0, blsize};
Point(56) = {0.024472, -0.032367, 0, blsize};
Point(57) = {0.035112, -0.038091, 0, blsize};
Point(58) = {0.047586, -0.043504, 0, blsize};
Point(59) = {0.061847, -0.048573, 0, blsize};
Point(60) = {0.077836, -0.053269, 0, blsize};
Point(61) = {0.09549199999999999, -0.057561, 0, blsize};
Point(62) = {0.114743, -0.061422, 0, blsize};
Point(63) = {0.135516, -0.064828, 0, blsize};
Point(64) = {0.157726, -0.067758, 0, blsize};
Point(65) = {0.181288, -0.070199, 0, blsize};
Point(66) = {0.206107, -0.07214, 0, blsize};
Point(67) = {0.232087, -0.073578, 0, blsize};
Point(68) = {0.259123, -0.074517, 0, blsize};
Point(69) = {0.28711, -0.074964, 0, blsize};
Point(70) = {0.315938, -0.074934, 0, blsize};
Point(71) = {0.345492, -0.074446, 0, blsize};
Point(72) = {0.375655, -0.07352300000000001, 0, blsize};
Point(73) = {0.406309, -0.07219299999999999, 0, blsize};
Point(74) = {0.437333, -0.07048699999999999, 0, blsize};
Point(75) = {0.468605, -0.068437, 0, blsize};
Point(76) = {0.5, -0.066077, 0, blsize};
Point(77) = {0.531395, -0.063442, 0, blsize};
Point(78) = {0.562667, -0.060568, 0, blsize};
Point(79) = {0.593691, -0.05749, 0, blsize};
Point(80) = {0.624345, -0.054242, 0, blsize};
Point(81) = {0.654508, -0.050858, 0, blsize};
Point(82) = {0.6840619999999999, -0.04737, 0, blsize};
Point(83) = {0.71289, -0.04381, 0, blsize};
```

```
Point(84) = {0.740877, -0.04021, 0, blsize};
Point(85) = {0.767913, -0.036598, 0, blsize};
Point(86) = {0.793893, -0.033006, 0, blsize};
Point(87) = {0.818712, -0.029461, 0, blsize};
Point(88) = {0.842274, -0.025994, 0, blsize};
Point(89) = {0.864484, -0.022632, 0, blsize};
Point(90) = {0.885257, -0.019404, 0, blsize};
Point(91) = {0.904508, -0.016339, 0, blsize};
Point(92) = {0.922164, -0.013463, 0, blsize};
Point(93) = {0.938153, -0.010804, 0, blsize};
Point(94) = {0.952414, -0.008387, 0, blsize};
Point(95) = {0.964888, -0.006237, 0, blsize};
Point(96) = {0.975528, -0.004377, 0, blsize};
Point(97) = {0.9842919999999999, -0.002825, 0, blsize};
Point(98) = {0.991144, -0.0016, 0, blsize};
Point(99) = {0.996057, -0.000715, 0, blsize};
Point(100) = {0.999013, -0.000179, 0, blsize};

//Punts per definir exterior
Point(103) = {-0.864484, 0, 0, esize};
Point(123) = {10, 10, 0, esize};
Point(135) = {10, -10, 0, esize};
Point(136) = {-0.864484, 10, 0, esize};
Point(137) = {-0.864484, -10, 0, esize};


//Linies per definir airfoil
Spline(1) = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13};
Spline(2) = {13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29};
Spline(3) = {29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 167};
Spline(9) = {167, 39, 166};
Spline(4) = {166, 40, 41, 42, 43, 44};
Spline(5) = {44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58};
Spline(6) = {58, 59, 60, 61, 62, 63, 64, 65, 66, 67,68, 69, 70, 71, 72, 73};
Spline(7) = {73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89};
Spline(8) = {89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 1};

//Linies per definir exterior
Circle(140)  ={136, 103, 137};
Line(141) =  {136, 123};
Line(142)={123, 135};
Line(143)={135, 137};
Line Loop (144) = {-140, 141, 142, 143};
Line Loop(145) = {1, 2, 3, 9, 4, 5, 6, 7, 8};


//Punts per definir airfoil exterior
```

```
Point(147) = {1.3, 0, 0, wlsize};
Point(148) = {0.88, 0.05, 0, wlsize};
Point(149) = {0.4, 0.11, 0, wlsize};
Point(151) = {-0.13, 0, 0, wlsize};
Point(153) = {0.4, -0.11, 0, wlsize};
Point(154) = {0.88, -0.05, 0, wlsize};
Point(155) = {0.125, -0.115, 0, wlsize};
Point(156) = {0.04, -0.08, 0, wlsize};
Point(158) = {0.04, 0.08, 0, wlsize};
Point(159) = {0.125, 0.115, 0, wlsize};
Point(160) = {0.65, -0.106, 0, wlsize};
Point(161) = {1.01, -0.008, 0, wlsize};
Point(162) = {0.65, 0.106, 0, wlsize};
Point(163) = {1.01, 0.008, 0, wlsize};
Point(164) = {0.94, -0.035, 0, wlsize};
Point(165) = {0.94, 0.035, 0, wlsize};
Point(168) = {0.12, 0.099, 0, wlsize};
Point(169) = {0.1501, 0.1028, 0, wlsize};
Point(170) = {0.269, 0.115, 0, wlsize};
Point(171) = {0.077, 0.092, 0, wlsize};

//Linies per definir airfoil exterior
BSpline(164) = {163, 165, 148};
BSpline(165) = {148, 162, 149};
BSpline(166) = {149, 170, 169};
BSpline(188) = {169, 168};
BSpline(189) = {168, 171, 158};
BSpline(167) = {158, 151, 156};
BSpline(168) = {156, 155, 153};
BSpline(169) = {153, 160, 154};
BSpline(170) = {154, 164, 161};
Line(171) = {161, 1};
Line(172) = {1, 163};
Line(173) = {148, 13};
Line(174) = {149, 29};
Line(175) = {158, 44};
Line(176) = {156, 58};
Line(177) = {153, 73};
Line(178) = {154, 89};
Line(179) = {168, 166};
Line(180) = {169, 167};

//Definicio de superficies

Line Loop(179) = {172, 164, 173, -1};
Line Loop(180) = {-173, 165, 174, -2};
Line Loop(181) = {-174, 166, 180, -3};
Line Loop(182) = {-175, 167, 176, -5};
```

```
Line Loop(183) = {-176, 168, 177, -6};
Line Loop(184) = {-177, 169, 178, -7};
Line Loop(185) = {-178, 170, 171, -8};
Line Loop(186) = {-180, 188, 179, -9};
Line Loop(187) = {-179, 189, 175, -4};
Plane Surface(1) = {179};
Plane Surface(2) = {180};
Plane Surface(3) = {181};
Plane Surface(4) = {182};
Plane Surface(5) = {183};
Plane Surface(6) = {184};
Plane Surface(7) = {185};
Plane Surface(8) = {186};
Plane Surface(9) = {187};
Line Loop(188) = {172, 164, 165, 166, 188, 189, 167, 168, 169, 170, 171};
Plane Surface(187) = {144, 188};

//Transfinite lines
nhor= 110;
nver= 60;
//horitzontals
Transfinite Line {1} = nhor Using Progression 1;
Transfinite Line {2} = nhor Using Progression 1;
Transfinite Line {3} = nhor Using Progression 1;
Transfinite Line {4} = nhor Using Progression 1;
Transfinite Line {5} = nhor Using Progression 1;
Transfinite Line {6} = nhor Using Progression 1;
Transfinite Line {7} = nhor Using Progression 1;
Transfinite Line {8} = nhor Using Progression 1;
Transfinite Line {9} = nhor Using Progression 1;

Transfinite Line {164} = nhor Using Progression 1;
Transfinite Line {165} = nhor Using Progression 1;
Transfinite Line {166} = nhor Using Progression 1;
Transfinite Line {167} = nhor Using Progression 1;
Transfinite Line {168} = nhor Using Progression 1;
Transfinite Line {169} = nhor Using Progression 1;
Transfinite Line {170} = nhor Using Progression 1;
Transfinite Line {188} = nhor Using Progression 1;
Transfinite Line {189} = nhor Using Progression 1;

//verticals
Transfinite Line {-171} = nver Using Progression 1.1;
Transfinite Line {172} = nver Using Progression 1.1;
Transfinite Line {-173} = nver Using Progression 1.1;
Transfinite Line {-174} = nver Using Progression 1.1;
Transfinite Line {-175} = nver Using Progression 1.1;
Transfinite Line {-176} = nver Using Progression 1.1;
```

```
Transfinite Line {-177} = nver Using Progression 1.1;
Transfinite Line {-178} = nver Using Progression 1.1;
Transfinite Line {-179} = nver Using Progression 1.1;
Transfinite Line {-180} = nver Using Progression 1.1;

//Tractament de superficies
Transfinite Surface {1};
Transfinite Surface {2};
Transfinite Surface {3};
Transfinite Surface {4};
Transfinite Surface {5};
Transfinite Surface {6};
Transfinite Surface {7};
Transfinite Surface {8};
Transfinite Surface {9};

Recombine Surface {1};
Recombine Surface {2};
Recombine Surface {3};
Recombine Surface {4};
Recombine Surface {5};
Recombine Surface {6};
Recombine Surface {7};
Recombine Surface {8};
Recombine Surface {9};


Extrude {0, 0, 2}
{
    Surface{1, 2, 3, 4, 5, 6, 7, 8, 9, 187};
    Layers{1};
    Recombine;
}

Physical Surface("airfoil") = {210, 232, 254, 386, 276, 298, 320, 342};
Physical Surface("inlet") = {407, 419};
Physical Surface("outlet") = {411, 415};
Physical Surface("frontAndBack") = {187, 464, 211, 233, 255, 365, 387, 277, 299, 321,
343, 1, 2, 3, 4, 5, 6, 7, 8, 9};
Physical Surface("jet") = {364};
Physical Volume("fluid") = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10};
```