PERSONAL AIR VEHICLES
vertical takeoff and landing (VTOL)
with oscillating wings type «umbrella»
Humanity has mastered varied types of transport:

- **Aircrafts, helicopters and airship**
- **Hovercraft**
- **Ground transport**

But personal air transport near the earth surface remains poorly mastered. The need for this type of transport is very large.
Range of tasks, which personal air vehicles vertical take-off and landing (VTOL) could perform, is huge. But all existing VTOL have serious disadvantages:

- small value of lifting force per unit of engine power;
- very low efficiency and, as a consequence, very small flight time and range;
- high cost;
- difficult take-off and landing;
- low maneuverability, including problems with hovering in place.

But these air vehicles are being designed and manufactured, because there are no better air vehicles on the market.
Data analysis

We have gathered a large database of personal air vehicles VTOL and their characteristics are listed below.

Next indicators are used as the basic characteristics:
- Specific thrust (the ratio of lifting force to the engine power);
- Specific emphasis (the ratio of lifting force to the total area of working bodies).

The histograms of these characteristics of aerial vehicles VTOL are listed below.

Unfortunately, many companies give incomplete information about their air vehicles VTOL, so the histogram shows only those VTOL, which had all the necessary characteristics.
Specific thrust of flying platforms VTOL

<table>
<thead>
<tr>
<th>Company/Model</th>
<th>Specific Thrust, kg/hp</th>
</tr>
</thead>
<tbody>
<tr>
<td>YouFly Cerwi S (Entecho Pty Ltd)</td>
<td>0.86</td>
</tr>
<tr>
<td>K004 ERV (Kuair Inc.)</td>
<td>1.05</td>
</tr>
<tr>
<td>YouFly Cerwi E (Entecho Pty Ltd)</td>
<td>1.23</td>
</tr>
<tr>
<td>Neura (Moller International)</td>
<td>1.36</td>
</tr>
<tr>
<td>Skycar 400 (Moller International)</td>
<td>1.51</td>
</tr>
<tr>
<td>Skycar 100 LS (Moller International)</td>
<td>2.14</td>
</tr>
<tr>
<td>EAGLE (DM AeroSafe)</td>
<td>2.27</td>
</tr>
<tr>
<td>EV 4A (Trek Aerospace)</td>
<td>2.28</td>
</tr>
<tr>
<td>UMR-2 (Trek Aerospace)</td>
<td>2.41</td>
</tr>
<tr>
<td>EFV 4B (Trek Aerospace)</td>
<td>2.81</td>
</tr>
<tr>
<td>Hummingbird (Flying platform AD &amp; D)</td>
<td>2.95</td>
</tr>
<tr>
<td>Skycar 200 LS (Moller International)</td>
<td>3.52</td>
</tr>
</tbody>
</table>

Companies-manufacturers of flying platforms

Our result - is 80 kg/hp!
Specific emphasis of flying platforms VTOL

Companies-manufactures of flying platforms

<table>
<thead>
<tr>
<th>Product</th>
<th>Specific emphasis, kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hummingbird flying platform (AD &amp; D)</td>
<td>68.4</td>
</tr>
<tr>
<td>YouFly Сериа E (Entecho Pty Ltd)</td>
<td>57.8</td>
</tr>
<tr>
<td>YouFly Сериа S (Entecho Pty Ltd)</td>
<td>73.7</td>
</tr>
<tr>
<td>K004 ERV (Kulair Inc)</td>
<td>393.1</td>
</tr>
</tbody>
</table>
Specific thrust of helicopters for 1-2 person

Companies-manufactures of helicopters for 1-2 person

Our result - is 80 kg/hp!
Specific emphasis of helicopters for 1-2 person

Companies-manufactures of helicopters for 1-2 person

- Alpi Syton AH 130 (Alpi Aviation)
- Exec 162F (RotorWay International)
- A600 Talon (RotorWay International)

Specific emphasis (the ratio of lifting force to the total area of working bodies), kg/m²

<table>
<thead>
<tr>
<th>Company</th>
<th>Specific Emphasis, kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpi Syton AH 130</td>
<td>12.69</td>
</tr>
<tr>
<td>Exec 162F</td>
<td>14.92</td>
</tr>
<tr>
<td>A600 Talon</td>
<td>15.00</td>
</tr>
</tbody>
</table>
Specific thrust of hovercraft

Companies-manufacturers of hovercraft

Our result - is 80 kg/hp!
Specific emphasis of hovercraft

Companies-manufactures of hovercraft

VertiScooter (AirBuoyant) - 303.47 kg/m²
AirBoard (Arbortech) - 99.52 kg/m²

Specific emphasis (the ratio of lifting force to the total area of working bodies), kg/m²
Conclusions

From the histograms and analysis of existing VTOL follow next:

1. VTOL have low specific lift between 0.8-5.2 kgf. / hp.

2. Hovercraft have high specific lift of 41 kgf. / hp., but have many disadvantages (low passability, bad controllability at small speeds, etc.)

3. Despite the huge number of developments of VTOL, their characteristics remain low, and as a consequence, despite the huge demand in VTOL, their distribution is delayed.

4. Most companies do not realize that they have no chance to create a highly economical, cheap and highly maneuverable VTOL because they use a screw propeller and stationary aerodynamics.

5. In order to create a VTOL with much better performance compared with existing analogues must go on completely new principles of lifting force and a pulling force for VTOL.
Our strategic direction for the creation of a new type of VTOL

1. Move to the development of VTOL based on the use of non-linear oscillatory aerodynamics.
2. To create propulsor with oscillating working body of the new type based on oscillatory aerodynamics.
3. To Use the energy of the jet of propulsor for the annihilation of aerodynamic drag of the vehicle body and increase thrust of propulsor.
4. To develop a working body (propulsor), based on the harmonization with the aerodynamic load.
5. Conduct working out the vehicle based on the unified oscillating system.

For a long time we had the great theoretical, experimental and design work on propulsors of oscillatory type. We got new great results.

We are confident that we can create a VTOL with propulsors of oscillatory type, which will have much better characteristics in comparison with all analogues.

Next, we present our results.
1. We received the following new results on nonlinear oscillatory aerodynamics (see also Sections 2 and 3):

1.1. we found a new structures of vortex around the oscillating body.

1.2. we found that at certain modes oscillations attached resilience occur in an incompressible fluid (like the well-known attached mass).

1.3. we developed the technique of experimental research of characteristics of propulsor of oscillatory type

1.4. We have developed methods of identify the characteristics of aerodynamic loads of oscillatory propulsor.

1.5. we have created a huge database of information by the oscillatory aerohydrodynamics, propulsors of oscillatory type (patents and publications), swimming and flying animals.

1.6. we have created a database of aerodynamic characteristics of oscillating bodies and wings on the basis of their experiments and published the results of scientist in journals.

Note. Results for 1.3-1.6 we can transmit on your order, see http://www.vortexosc.com/modules.php?name=Content&pa=showpage&pid=201
2.2. Increase of rationality of use of propulsor’s swept area.

Propulsor "oscillating wing" doesn’t have such disadvantages, which a screw propulsor has: the absence of thrust in the rotor about an axis, the inductive aerodynamic drag at the ends of the blades, adverse movement of air to the ends of the blades due to centrifugal forces.
2.3. The increase in the effective area which is swept by propulsor (KNOW HOW).

There are regimes of nonlinear hydrodynamic fluctuations of the wing, where the effective swept area is much larger than the area which geometrically swept by wing at steady-state oscillation.

Due to this effect the value of traction can be much greater.
2.4. The increase in thrust thanks to the fact that the vortex shedding from the wing at oscillation occurs at high angles of attack (KNOW HOW).

Thrust on the propulsor type «oscillating wing» is a projection of the lifting force on the vertical direction.

When the wing oscillates, there is a failure of flow and, consequently, the fall of the lifting force will occur at a much greater angle of attack.

Thanks to this, the coefficients of lifting force will have much greater values than a screw propulsor has.
Using the results of § 2.1-2.4 can be obtained a propulsor with the following characteristics:

1. Thanks to the aerodynamic effects of 2.1- § 2.4, obtained a large thrust and greater efficiency than screw propulsors have. We received experimentally on oscillating wing in mode on the spot more than 150 kg / hp. At transition to the real vehicle, taking into account losses in the engine and transmitting-matching elements, we obtain 80 kg / hp. This is 10 times better than the screw propulsors have in mode on the spot.

2. Several wings-propulsors with separate adjustment will provide movement in any direction (six degrees of freedom). Better handling at low speeds.

3. Safety (contact with the wing is safe, do not require protective fencing); Oscillating wing does not injure a human or fish.

4. A little traces

5. Simple wing instead screw of complex configuration (simplicity and cheapness to manufacture).

6. Reduced stiffness of the requirements for the location of the power units and control systems on the vehicles.

7. The smaller dimensions of the vehicle with the same payload.

8. Aesthetic appearance of the vehicles with an oscillatory propulsor is much more attractive than with the screw propulsor.
3. The annihilation of the aerodynamic resistance of the VTOL hull using effect Zhukovsky-Knoller-Betz (KNOW HOW)

3.1. We conducted calculations of the specific aerodynamic interaction with the body in the wing form. Calculations show (see left image) that at oscillatory stream can be reduced aerodynamic resistance to zero or even body can be a propulsor!

3.2. We have conducted experimental research which confirmed this (see right figure - it is a stand on which the experiments were made.)
3.3. Experiments of interaction of a oscillating wing with a motionless wing in hovering mode at place were made. The thrust increased by 20 % in comparison with thrust of a oscillating wing without motionless wing!

3.4. We found a aerodynamic scheme (which we tested experimentally) when the energy on reduction of aerodynamic resistance are takes from energy, which oscillatory propulsor lost.
I.e. an additional energy on reduce of aerodynamic resistance of the hull is not spent at all!

3.5. This is a little-known effect of Zhukovsky-Knoller-Betz.

3.6. Analysis of works about the effect of the wave flow was conducted by E.D. Sorokodum together with a outstanding American expert in oscillatory aerodynamics the Dr. M.F. Platzer and published in the journal:

3.7. Conclusions for Section 3:

1. Can be reduced aerodynamic resistance of vehicle in several times without wasting energy on it.

2. It can be used:
   • or for reducing of engine power;
   • or for increase the time flying;
   • or for increase the payload;
   • or for increase the speed and range of flying of apparatus at the same power engine.
4. Working body (propulsor) to develop on the basis of consent with the aerodynamic load.

Traditionally, developers are considering an oscillating wing as an ordinary body. This is a very big mistake. Oscillating wing is a very complex oscillatory system, which perform many functional tasks. We know how to calculate and construct such oscillating wing (KNOW HOW).

5. Conduct development of the vehicles based on a unified oscillating system.

Apparatus with motor-propulsion complex of oscillatory type is a unified oscillating system. We know work principles of this system, and we can develop it (KNOW HOW).
6. Management of the motor-propulsion complex of VTOL
(6 degrees of freedom of movement)

Block of manual Control. Characteristics of propulsor
(frequency and amplitude of the oscillation, the mean position of the oscillating wing)

Block of automatic finding of optimum operating modes (optimum operation modes of propulsor: maxima thrust or maxima efficiency)
The aerial vehicles of vertical take-off with propulsor of oscillatory type will have:

1. A smaller engine power because thrust is required in some times smaller.
2. Lighter weight of engine, transmission components, fuel system, fuel.
3. The smaller dimensions of the device with the same payload.
4. Vertical take-off, lowering, turning and hovering in place;
5. Better handling at low speeds;
6. These aerial vehicle generates lift forces and thrust with the same oscillating working elements (KNOW-HOW).
7. The cost of the device will be lower.
8. Transportation of commercial cargo will be cheaper.
9. Safety of transportation and increase in controllability and maneuverability.
10. Safety (contact with the wing safe, did not require protective fencing);
11. Reduced stiffness of the requirements for the location of the power units and control systems on the vehicles.
12. Aesthetic appearance of the aerial vehicles with an oscillatory propulsor is much more attractive than the screw propulsor.
<table>
<thead>
<tr>
<th>Name of the stage</th>
<th>Duration of the stage, months</th>
<th>Unit cost, thousand dollars</th>
<th>Quantity, pcs</th>
<th>Expenses, million dollars</th>
<th>Selling price per unit, thousand dollars</th>
<th>Revenues from sales, million dollars</th>
<th>Profit/ Loss, million dollars</th>
<th>Net profit/ loss (with subtraction of profit tax), million dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D of mini aerial vehicle the type of &quot;umbrella&quot;</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>0</td>
<td>-1.97</td>
<td>-1.97</td>
</tr>
<tr>
<td>R&amp;D of aerial vehicle the type of &quot;umbrella&quot; with flying weight 250 kg</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>0</td>
<td>-0.09</td>
<td>-0.09</td>
</tr>
<tr>
<td><strong>Total R&amp;D</strong></td>
<td>24</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>0</td>
<td>-1.97</td>
<td>-1.97</td>
</tr>
<tr>
<td>International marketing</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>0.09</td>
<td>-</td>
<td>0</td>
<td>-0.09</td>
<td>-0.09</td>
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<tr>
<td>Production of the 1st batch of mini aerial vehicle</td>
<td>3</td>
<td>3,125</td>
<td>5</td>
<td>0.02</td>
<td>37.5</td>
<td>0.19</td>
<td>0.17</td>
<td>0.14</td>
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<tr>
<td>Production of the 2nd batch of mini aerial vehicle</td>
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<td>2,187</td>
<td>50</td>
<td>0.11</td>
<td>37.5</td>
<td>1.88</td>
<td>1.77</td>
<td>1.41</td>
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</table>
### Financial Plan

**continuation of the Table 1**

<table>
<thead>
<tr>
<th>Name of the stage</th>
<th>Duration of the stage, months</th>
<th>Unit cost, thousand dollars</th>
<th>Quantity, pcs</th>
<th>Expenses, million dollars</th>
<th>Selling price per unit, thousand dollars</th>
<th>Revenues from sales, million dollars</th>
<th>Profit/ Loss, million dollars</th>
<th>Net profit/ loss (with subtraction of profit tax), million dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial production of mini aerial vehicle, 1st year</td>
<td>12</td>
<td>1,25</td>
<td>50000</td>
<td>62,5</td>
<td>9,375</td>
<td>468.75</td>
<td>406.25</td>
<td>325</td>
</tr>
<tr>
<td>Serial production of mini aerial vehicle, 2nd year</td>
<td>12</td>
<td>1,25</td>
<td>100000</td>
<td>125</td>
<td>9,375</td>
<td>937.5</td>
<td>812.5</td>
<td>650</td>
</tr>
<tr>
<td>Production of the 1st batch of aerial vehicle with flying weight 250 kg</td>
<td>3</td>
<td>3,125</td>
<td>5</td>
<td>0,02</td>
<td>25</td>
<td>0.125</td>
<td>0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>Serial production of aerial vehicle with flying weight 250 kg, 1st year</td>
<td>12</td>
<td>1,875</td>
<td>50000</td>
<td>3,9</td>
<td>15,625</td>
<td>781,25</td>
<td>777.34</td>
<td>621.88</td>
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<tr>
<td>Serial production of aerial vehicle with flying weight 250 kg, 2nd year</td>
<td>12</td>
<td>1,875</td>
<td>250000</td>
<td>468,75</td>
<td>15,625</td>
<td>3906,25</td>
<td>3437.5</td>
<td>2750</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>48</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>664.34</strong></td>
<td><strong>-</strong></td>
<td><strong>6095.94</strong></td>
<td><strong>3244.89</strong></td>
<td><strong>2595.9</strong></td>
</tr>
</tbody>
</table>
Table 1 shows:

For R&D of aerial vehicle the type of "umbrella" with flying weight 250 kg is required 1 million dollars and one year (roughly, depends on the specification).

During 4 years net profit of 2595.9 million is expected.
Our offers

We are looking for an investor and partner to create a new type of super-effective VTOL with propulsor of oscillatory type.

We have a great theoretical, experimental and practical experience in the design and manufacture of samples of the equipment using oscillations.

We can develop and produce the first exemplars of VTOL for various purposes.
After getting acquainted with our presentation, some experts will may mistakenly think that they themselves, without us, can create personal air vehicles vertical takeoff and landing (VTOL) with propulsor of oscillatory type. This is an illusion.

Oscillatory aerodynamics - is a new, poorly studied area of aerodynamics (we know this area better than anyone), and the principles of R & D - is an innovative and unknown for usual aviation scientists and designers.

These experts are not able to create a super-efficient air vehicles, and they only will bring huge losses to the company.
Contacts

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