

COMPUTERIZED AIRDROPPED CARGO DELIVERY SYSTEM

FIELD OF THE INVENTION

[0001] The present invention generally relates to a method and system for delivering cargo from the air to the ground.

BACKGROUND TO THE INVENTION

[0002] Typically, when cargo or supplies are dropped from an aerial vehicle, such as for humanitarian relief in remote locations in case of calamities, or for a military operation in a time of tension, it is highly important to ensure that the cargo does not land on a wrong spot, that the cargo is intact; and in some cases, that the cargo has landed in a required posture.

[0003] In the case where the cargo is a medical device or a video camera or an electro-optics system for surveillance purposes or a life saving asset, it is particularly difficult and cumbersome to land the cargo substantially within a required Circular Error Probable (CEP) and to ensure that it is generally in an upright position when the cargo has landed on the ground. The accuracy of landing a cargo using a parachute and in particular the requirements of a specific posture of the landed position of a cargo is potentially aggravated with a gust of wind and adverse environmental conditions at the time when the cargo is launched from the aerial vehicle and during the airdrop.

1 **[0004]** Moreover, operations of Special Forces are sometimes hampered by
2 the limited amount of cargo that a paratrooper can carry under his parafoil. An air
3 dropped cargo delivery system can alleviate hazards of overloading the paratroopers.

4
5 **[0005]** Existing practices of dropping sensors from the air uses Vertical Take
6 Off and Landing (VTOL) Unmanned Aircraft Vehicle (UAV) to land the sensors, or a
7 Global Positioning System (GPS) to guide a parachute carrying sensors to land the
8 sensors, or simply dropping sensors wrapped in spongy materials from the UAV.
9 However, the existing practices are not cost effective.

10

11 **[0006]** Thus, there is need for a cost effective alternative for deploying these
12 sensors accurately within the Circular Error Probable (CEP) and a need to ensure that
13 the cargo is generally in an upright position when it has landed on the ground.

14

15 **SUMMARY OF THE INVENTION**

16 **[0007]** In accordance with a first aspect, a method for delivering cargo from
17 an aerial vehicle to a target area comprising forming a system which has a nosecone, a
18 tailfin, and an exterior module having an upper and lower halves and an interior
19 module containing the cargo. The exterior module has an exterior abrasion resistant
20 protective cover, an energy absorption layer between the interior module and the
21 exterior module; and between the inner wall of the interior module and the housings
22 containing the cargo and the operating systems to ensure that the cargo and its
23 operating systems remain intact after the air drop. The method further comprises
24 dropping the system over a target area and thereafter demagnetize electro-magnets,
25 activate solenoid plungers and triggering a latching mechanism which separates the

nosecone and tailfin respectively from the exterior module; and allowing the exterior module to land and bounce and to settle generally in an upright position; and deploying the cargo above a predetermined height from the ground to look over obstacles after the exterior module has settled.

[0008] From the foregoing disclosure and the following more detailed description of various preferred embodiments, it will be apparent to those skilled in the art that the present invention provides a significant advance in the technology of delivering cargo from the air to a target area on the ground. Particularly significant in this regard is the potential the invention affords for providing a cost effective alternative for deploying cargos and, in particular sensors accurately within the Circular Error Probable (CEP) and a need to ensure that the cargo is generally in an upright position after it has landed on the ground. The cargo can be sensors for surveillance purposes and the cargo can by itself form a node in a multi-nodes wireless sensor network. Additional features and advantages of various preferred embodiments will be better understood in view of the detailed description provided below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Fig. 1 shows a cross-sectional view of the preferred embodiment of the system being deployed.

[0010] Fig 2 shows a cross-sectional view of the system of Fig.1 in a detached state.

[0011] Fig 3 shows a cross-sectional view of the exterior module bouncing on the ground after the detachment of the nosecone and tailfin of the system at a

predetermined altitude causing the exterior module containing the interior module which carries the cargo to have free fall to the ground and bouncing when landing.

[0012] Fig 4 shows a cross-sectional view of the exterior module after the cargo is deployed.

[0013] It should be understood that the appended drawings are not necessarily to scale, presenting a somewhat simplified representation of various preferred features illustrative of the basic principles of the invention. The specific design features of the system for delivering cargo from the air to the ground as disclosed herein, including, by way of example, the specific dimensions of the cargo delivering system, will be determined in part by the particular intended application and use environment. Certain features of the illustrated embodiments have been enlarged or emphasized relative to others to help provide clear understanding. In particular, thin features may be thickened, for example, for clarity of illustration. All references to direction and position, unless otherwise indicated, refer to the orientation illustrated in the drawings.

DETAILED DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS

[0014] It will be apparent to those skilled in the art, that is, to those who have knowledge or experience in this area of technology, that many uses and design variations are possible for delivering cargo from the air to the ground are disclosed herein. The following detailed discussion of various alternative and preferred features and embodiments shall illustrate the general principles of the invention with reference to a system suitable for delivering cargo from the air to the ground. Other embodiments suitable for other applications shall be apparent to those skilled in the art given the benefit of this disclosure.

1 **[0015]** Turning now to the drawings, Fig. 1 shows a cross section of the
2 system 100 after launching from the cargo delivery bay 108 of the aerial vehicle. The
3 system 100 comprises of a tailfin 101, a nosecone 102 and an exterior module 103.
4 The nosecone 102 is attached to the lower half of the exterior module 103 through
5 electro-magnets 125 and soft irons. The tailfin 101 is at the upper half of the exterior
6 module 103 as shown in Fig. 1. The system 100 can be deployed from a system
7 delivery bay 108 of an aerial vehicle. The exterior module 103 has a zipped exterior
8 cover 104. The exterior cover 104 can be a zipped bag made up of flexible and
9 abrasion resistant material such as nylon, neoprene, plastic, kevlar fabric, 200 denier
10 Yarn, Vectran HS, softgoods materials, canvas or special polymers. The exterior
11 module 103 which can be an egg shape honeycomb structure which attenuates shocks
12 due to impacts caused by bouncing on the ground, and alleviates shocks to be
13 transmitted to an interior module 106. The shape of the interior module is designed
14 and built and arranged to fit the cargo and an energy absorbing structure inside the
15 interior module, such that the centre of gravity of the exterior module and the interior
16 module collectively is in the lower half of the two modules. The shock and vibrations
17 due to impacts caused by bouncing on the ground are also absorbed by an energy
18 absorption layer 105 placed between the exterior and interior modules; and the energy
19 absorption structure located between the inner wall of the interior module 106 and the
20 housings of the cargo 110. The energy absorption structure is secured to an inner wall
21 of the interior module 106 with screws and rubber grommets.

22
23 **[0016]** The exterior module 103 generally has an egg-shaped cross-section
24 and the bottom of the exterior module 103 is lined with heavy material such as lead to
25 lower the center of gravity of the exterior module 103 to assist it to be generally in an

1 upright position after it has settled on the ground after the freefall. Preferably the
2 interior module 106 is positioned within the exterior module 103 as shown in the Figs.
3 The space between the interior module 106 and the housings can contain cargo 110 or
4 an electro-optics system 115, a rack and pinion system 109 and a DC motor 111, an
5 unlatching servomotor 119 and a pan-tilt servomotor 141, latching mechanism which
6 comprises a latch 117 and a spring 118, an interior module battery 127 and a
7 microprocessor 112.

8
9 **[0017]** The space between the interior module 106 and the housings can also
10 comprise a GPS antenna 131 and a GPS location transmitter 132, an acoustic sensor
11 133 and an acoustic sensor transmitter 134, a seismic sensor 135 and a seismic sensor
12 transmitter 136. The space between the interior module 106 and the housings can also
13 comprise an energy absorbing structure such as flexible carbon composite supports
14 107 attached to the inner wall of the interior module 106 with screws and rubber
15 grommets to attenuate vibration and absorb energy due to impact caused by bouncing.
16 The energy absorbing structure can have a honeycomb shape. The tailfin 101, the
17 exterior module 103 and the nosecone 102 collectively streamline the system 100 and
18 improve the aerodynamics of the free fall of the system 100 to enhance the accuracy
19 of landing and to reduce the circular error probable. The circular error probable is
20 generally affected by the shape and aerodynamics of the free fall body, the wind load
21 and direction, and the weight of the system.

22
23 **[0018]** The rack and pinion system 109 acts as a lifting device, the pinion of
24 which is driven by the DC motor 111 controlled by the microprocessor 112. The rack
25 and pinion system 109 preferably has the cargo 110 which can be an electro-optics

1 system 115 mounted on the pan-tilt servomotor 141 which in turn is attached to one
2 end of the rack as shown in Fig. 1. The cargo 110 can contain operating systems. The
3 rack and pinion system 109 lifts the cargo 110 above the exterior module 103 to look
4 over obstacles after all of the following conditions are met:

5 (i) triggering a triggering mechanism which separates the nosecone and tailfin
6 from the exterior module. The triggering mechanism comprises a microprocessor 112
7 which receives a wireless signal through a radio receiver 114 in the interior module
8 106 that the distance sensor 137 in the nosecone 102 has detected that the nosecone
9 102 has reached a predetermined altitude above the target area 139 on the ground.
10 Once the wireless signal from the distance sensor is received, a signal is sent from the
11 microprocessor 112 to the unlatching servomotor 119 commanding unlatching and
12 ejection of the tailfin 101; and

13 (ii) measuring that movement of the exterior module 103 has ceased. The
14 microprocessor 112 had detected through an accelerometer 113 that there is no more
15 acceleration and vibrations due to the bouncing of the exterior module 103 after it had
16 landed on the ground. The electro-optics system 115 can have a wireless transmitter, a
17 digital compass, and a microphone, and is placed on top of the pan-tilt servomotor
18 141 which in turn is mounted on top of the rack and pinion system 109. The pan-tilt
19 servomotor 141 is used for panning and/or tilting the electro-optics system 115
20 through a wireless remote control receiver 116 with a remote controller at the base
21 station.

22
23 **[0019]** The electro-optics system 115 can also be equipped with an image
24 intensifier and/or a thermal intensifier and hence the power required to produce and
25 transmit the video signal wirelessly can be substantial. Therefore, the microprocessor

1 112, which controls among other things, the electro-optics system 115, is normally in
2 sleep mode when no signal is received from sensors such as acoustic sensor 133 or
3 seismic sensor 135. The interior module 106 also has a latch 117 and a compression
4 spring 118. The interior module 106 can comprise a GPS antenna 131 and a GPS
5 location transmitter 132, an acoustic sensor 133 and an acoustic sensor transmitter
6 134, a seismic sensor 135 and a seismic sensor transmitter 136.

7

8 **[0020]** The energy absorption layer 105 can be made up of a plurality of
9 inflatable balls, rubber or plastic grommets, air bags or sheets with shock absorbing
10 and impact resistance properties. Preferably, the energy absorption layer 105 totally
11 surrounds the interior module 106 except the opening on top of the exterior module
12 103 and the interior module 106 where the shaft 120 of tailfin 101 passes, to attenuate
13 shocks and vibration due to impacts caused by the bouncing of the external module
14 103 after it has landed on the ground. The exterior cover 104 can be a nylon, canvas,
15 polymer or kevlar zipped bag. A shaft 120 of the tailfin 101 can be latched with a
16 latching mechanism housed in the interior module 106. A cam is mounted on the
17 unlatching servomotor 119. When the latching mechanism is activated by the cam
18 mounted on the unlatching servomotor 119 to unlatch the tailfin 101 as commanded
19 by the microprocessor 112 when the distance sensor 137 in the nosecone 102 detected
20 that the system 100 has a free fall to a predetermined altitude from the ground, a
21 helical compression spring 122 ejects the tailfin 101. The shaft 120 of the tailfin 101
22 extends through a tube 121 located between an opening at the top of the exterior
23 module 103 and an opening at the top of the interior module 106 as shown in figure 1.
24 The tube 121 creates an opening for the cargo 110 or the electro-optics system 115 to
25 be raised above the exterior module 103 after the tailfin 101 is ejected.

1

2 **[0021]** The nosecone 102 comprises a left half 123 and a right half 124.
3 Preferably, the left half 123 has a plurality of electromagnets 125 and the right half
4 124 and the bottom of the exterior module 103 has soft irons that when the
5 electromagnets 125 are energized, secure the left half 123 and the right half 124
6 together and at the same time secure the nosecone 102 to the bottom of the exterior
7 module 103. The electromagnets 125 are energized by electrical power from a
8 nosecone battery 140 controlled by a nosecone microprocessor 128. The nosecone
9 microprocessor 128 can also be programmed to create a command at a predetermined
10 altitude above the target area 139 measured by the distance sensor 134 to demagnetize
11 the electro-magnets 125 to separate the left half 123 and the right half 124 and to eject
12 the tailfin 101. The nosecone battery 140 and the nosecone microprocessor 128 are
13 both housed in the nosecone 102.

14

15 **[0022]** When energized, the electromagnets 125 on the left half 123 are
16 magnetically secured to soft iron plates attached to the right half 124. Similarly, when
17 energized, the electromagnets 125 on the top of the left half 123 are magnetically
18 secured to the soft iron plates attached to the bottom of the exterior module 103. The
19 left half 123 preferably has solenoid plungers 126 which can be spring loaded. When
20 the system 100 is dropped to a predetermined altitude measured by the distance sensor
21 137 housed in the nosecone 102, the nosecone microprocessor 128 turns off the power
22 to the electromagnets 125, demagnetizing the electromagnets 125, and at the same
23 time activates all the solenoid plungers 126.

24

1 **[0023]** The solenoid plungers 126 separate the left half 123 from the right half
 2 124. At the same time, the electromagnets holding the nosecone 102 and the exterior
 3 module 103 together are demagnetized allowing the exterior module 103 to have a
 4 free fall to the ground. At the same time, the nosecone microprocessor 128 sends a
 5 wireless signal through a radio transmitter 130 in the nosecone 102 to the
 6 microprocessor 112 through a radio receiver 114 to eject the tailfin 101. The left half
 7 123 preferably has a distance sensor 137 installed at its tip. The distance sensor 137
 8 can be ultrasonic, radar, laser or infrared. The system delivery bay 108 is preferably
 9 equipped with a delivery bay transmitter 138 which sends a wireless signal, through
 10 the nosecone receiver 129 in the nosecone 102 to either:-

11 (i) the nosecone microprocessor 128 or

12 (ii) a timer, which can be a component of the nosecone microprocessor 128,
 13 when the system 100 is dropped from the bay 108. Distance sensor 137 may not be
 14 required when the height of the release of the system 100 from the aerial vehicle is
 15 known. In this case, when the system 100 is dropped from the system delivery bay
 16 108, the delivery bay transmitter 138 sends a radio signal to a timer or the timer in the
 17 nosecone microprocessor 128 through the nosecone receiver 129 in the nosecone 102
 18 to initiate the measurement of time of free fall. At a preset time, the left half 123 and
 19 the right half 124 of the nosecone 102 can be separated and at the same time, the
 20 nosecone 102 is separated from the exterior module 103 allowing the exterior module
 21 103 to have a free fall to the ground.

22

23 **[0024]** With reference to Fig. 1, when the system delivery bay 108 opens and
 24 the system 100 is deployed, the delivery bay transmitter 138 sends a signal to the
 25 nosecone microprocessor 128 in the nosecone 102 through the receiver 129 in the

1 nosecone 102, commanding the distance sensor 137 to start measuring the distance
2 between the tip of the nosecone 102 and the ground. When the preset distance
3 between the nosecone 102 and the ground is sensed by the distance sensor 137, a
4 signal is relayed to the microprocessor 112 in the interior module 106 via the radio
5 transmitter 130 in the nosecone 102. Microprocessor 112 then triggers in real time
6 the ejection of the tailfin 101 by rotating a cam mounted on top of the unlatching
7 servomotor 119 to activate the latch 117 to eject the tailfin 101.

8
9 **[0025]** With reference to Fig. 2, when a preset altitude is sensed by the
10 distance sensor 137 after the system 100 is dropped from the cargo delivery bay 108,
11 a signal is sent to the nosecone microprocessor 128 causing the nosecone battery 140
12 to stop powering the electromagnets 125. The nosecone microprocessor 128 also
13 sends a signal to activate the solenoid plungers 126 to push and separate the left half
14 123 and the right half 124 from one another and from the exterior module 103. The
15 solenoid plungers 126 are also used to overcome the residual magnetic pull of the
16 electromagnets 125 after the nosecone battery 140 has stopped energizing the
17 electromagnets 125 and to separate the left half 123 and the right half 124 to create a
18 clear space for the exterior module 103 to have a free fall to the ground. Due to the
19 egg shape configuration of the exterior module 103 and the speed that the exterior
20 module 103 is free falling, the lift and the aerodynamics of the airdropped system is
21 changed once the nosecone 102 is separated from the exterior module 103.

22
23 **[0026]** Simultaneously, and also with reference to Fig. 2, the microprocessor
24 112 in the interior module 106 sends a signal to the unlatching servo-motor 119 which
25 operates a cam to release a latch 117, which in turn causes the tailfin 101 to be

1 separated from the exterior module 103 with the assistance of the helical compression
2 spring 122 which ejects the tailfin 101 away from the exterior module 103. The
3 microprocessor 112 will also activate the accelerometer 113 to begin to measure the
4 acceleration of the exterior module 103 The cargo 110 or the electro-optics system
5 115 shall only be raised above the exterior module 103 when there is no more
6 acceleration or vibration detected by the accelerometer 113 indicating that the exterior
7 module 103 have landed and there is no more bouncing.

8
9 **[0027]** With reference to Fig. 3, after the exterior module 103 free falls to the
10 target area 139, the energy absorption layer 105 and the specially designed energy
11 absorbing flexible carbon composite structures 107 held by screws and rubber
12 grommets and the structure stretches between the inner wall of interior module 106
13 and the housings containing: the cargo 110 or the electro-optics system 115, the
14 unlatching servomotor 119 and the pan-tilt servomotor 141, the latching mechanism
15 which comprises the latch 117 and spring 118, the rack and pinion system 109, the
16 DC motor 111, the microprocessor 112, the interior module battery 127, the radio
17 receiver 114 and wireless remote control receiver 116, absorbs the energy due to
18 impacts. The exterior module 103 is allowed to bounce freely on the ground until it is
19 stationary and settles generally in an upright posture. The energy absorbing layer
20 between the exterior module 103 and the interior module 106 and the specially
21 designed energy absorbing flexible carbon composite structure 107 and the screws
22 and rubber grommets which holds the structure 107 advantageously maintains the
23 integrity of the cargo 110 such that the cargo 110 is fully functional once the exterior
24 module 103 settles. The exterior module 103 is preferably egg shaped and can be
25 provided with ballast which is securely fixed at the lower half of the interior module

1 106. This advantageously keeps the exterior module 103 in an upright posture after it
2 settles on the ground. A heavy object such as a sandbag or lead can also be securely
3 attached to the interior module 106 to lower the centre of gravity of the exterior
4 module 103.

5
6 **[0028]** With reference to Fig. 4, the accelerometer 113 in the interior module
7 106 will indicate to the microprocessor 112 that the external module 103 and the
8 interior module 106 are stationary, and microprocessor 112 will send a signal to start
9 the DC motor 111 to drive the rack and pinion system 109 to deliver the cargo 110
10 through the tube 121. The cargo 110 can be a video camera or an optical equipment.
11 In another preferred embodiment, the cargo can be humanitarian supplies, medical
12 device, food or other deliverables etc. The rack and pinion system 109 is able to
13 deploy the optical equipment to a height so that the optical equipment can look over
14 obstacles. The wireless transmitter in the electro-optics system 115 would then
15 transmit the data captured by the optical equipment wirelessly to the remote base
16 station. The data includes but not limited to the image and thermal intensified video
17 and audio signals of the target, the longitude and latitude of the exterior module 103,
18 the identification of the node that is transmitting the data, the direction of the target,
19 the acoustics and seismic signals. The wireless remote control receiver 116 would
20 receive control signals from the remote base station and thus an operator in the remote
21 base station advantageously will be able to control the pan-tilt servomotor 141 of the
22 optical equipment remotely.

23
24 **[0029]** As previously mentioned in paragraph [0019], the microprocessor 112
25 is normally in a sleep mode. In cases when the acoustics sensor 133 and/or seismic

1 sensor 135 receive signals after the exterior module 103 is stationary, or the operator
2 in the remote base station decides to view the environment with the electro optics
3 system 115 or cargo 110 (e.g., a video camera or a microphone) by sending a wireless
4 signal to the microprocessor 112, then the microprocessor 112 will receive an
5 interrupt and wakeup to operate the electro-optics system 115. The operator in the
6 remote base station wirelessly and remotely operates the pan-tilt servomotor 141 to
7 the direction of the signals. The GPS antenna 131 and the GPS location transmitter
8 132 which is placed inside the interior module 106 will provide the latitude and
9 longitude of the location of the exterior module 103. The digital compass inside the
10 electro-optics system 115 provides the azimuth.

11

12 **[0030]** As there could be many external modules 103 being dropped in an area,
13 each external module 103 could be a node in multi-node wireless sensor network..
14 Hence, data including but not limited to the following: the identification of an
15 individual node, the latitude and longitude of the node, the azimuth of the direction of
16 view of the electro optics system 115, and the audio-video of the object generating the
17 acoustic and/or seismic signals or the surroundings are transmitted wirelessly to the
18 operator in the remote base station.

19

20 **[0031]** In an alternative embodiment, when the altitude of the aerial vehicle is
21 known before the aerial vehicle drops the system 100, system 100 does not need to
22 have a distance sensor 137 as part of the triggering mechanism but instead uses a
23 timer. In this embodiment, the optimum altitude for the disengagement of the tailfin
24 101 and nosecone 102 from the exterior module 103 is predetermined as an altitude at
25 a given time after deployment of system 100. Therefore, when the system delivery

1 bay 108 opens and the system 100 is deployed, the delivery bay transmitter 138 sends
2 a signal to the radio receiver 114 and the nosecone receiver 129, initiating the timer in
3 the microprocessor 112 and the timer in the nosecone microprocessor 128 start timing,
4 and incrementing the timer. The triggering mechanism will be activated when time
5 increments to a preset value.

6

7 **[0032]** From the foregoing disclosure and detailed description of certain
8 preferred embodiments, it will be apparent that various modifications, additions and
9 other alternative embodiments are possible without departing from the true scope and
10 spirit of the invention. The embodiments discussed were chosen and described to
11 provide the best illustration of the principles of the invention and its practical
12 application to thereby enable one of ordinary skill in the art to use the invention in
13 various embodiments and with various modifications as are suited to the particular use
14 contemplated. All such modifications and variations are within the scope of the
15 invention as determined by the appended claims when interpreted in accordance with
16 the breadth to which they are fairly, legally, and equitably entitled.

1 CLAIMS

2 1. A method for delivering cargo from an aerial vehicle to a target area
3 comprising, in combination the steps of:

4 encasing the cargo in a system, wherein the system has a circular error
5 probable when deployed;

6 dropping the system;

7 allowing the system to land, to bounce and to settle in an upright position,

8 wherein the circular error probable of the system is within the target area; and

9 deploying the cargo above a predetermined height after the system has settled.

10

11 2. A method for delivering cargo from an aerial vehicle to a target area
12 comprising, in combination the steps of:

13 forming a system which comprises a nosecone, a tailfin, an exterior module

14 having an upper half and a lower half, the exterior module comprising an exterior

15 cover, an interior module containing cargo, and an energy absorption layer between

16 the exterior module and the interior module; and the interior module having an energy

17 absorbing structure to protect the cargo;

18 dropping the system over a target area;

19 triggering a triggering mechanism which separates the nosecone and tailfin

20 from the exterior module;

21 allowing the exterior module to land and to settle in an upright position; and

22 deploying the cargo above a predetermined height after the exterior module

23 has settled.

24

1 3. The method of claim 2 wherein the exterior module has a center of gravity at
2 the lower half.

3

4 4. The method of claims 2 or 3 wherein the energy absorption layer between the
5 exterior module and the interior module totally surrounds the interior module except
6 for an opening for a shaft of the tailfin.

7

8 5. The method of any one of claims 2 to 4 wherein the energy absorption layer
9 between the exterior module and the interior module comprises one of inflatable balls,
10 air bags, rubber or plastic grommets, sheets with shock absorbing and impact
11 resistance properties , and any combinations of the materials.

12

13 6. The method of any one of claims 2 to 5 wherein the exterior cover of the
14 exterior module is a zipped bag that comprises one of nylon, neoprene, plastic, kevlar
15 fabric, 200 denier Yarn, Vectran HS, softgoods, canvas, special polymers and any
16 combinations thereof.

17

18 7. The method of any one of claims 2 to 6 wherein the exterior module has an
19 egg-shaped cross section.

20

21 8. The method of any one of claims 2 to 7 wherein the nosecone is at the lower
22 half of the exterior module and the tailfin is at the upper half of the exterior module.

23

24 9. The method of any one of claims 2 to 8 wherein the nosecone comprises a
25 microprocessor and the interior module comprises a microprocessor.

1

2 10. The method of claim 9 wherein the nosecone further comprises a distance
3 sensor, and the distance sensor acts as part of the triggering mechanism, and the
4 nosecone and tailfin are separable from the exterior module when the distance sensor
5 senses that the system is at a predetermined altitude from the target area, a signal is
6 sent to the microprocessor in the nosecone and a wireless signal is sent to the
7 microprocessor in the interior module.

8

9 11. The method of any one of claims 2 to 8 further comprising a timer on the
10 nosecone and a timer in the interior module, wherein the nosecone and tailfin are
11 separable from the exterior module when the time of either timer reaches a certain
12 value after the system is deployed.

13

14 12. The method of any one of claims 2 to 11 wherein upon contact with the target
15 area, the exterior module bounces prior to settling in the upright position.

16

17 13. The method of any one of claims 2 to 12 wherein the interior module
18 comprises an accelerometer which measures the acceleration and/or vibration of the
19 interior module and exterior module, and the cargo comprises electro-optics such as a
20 video camera with or without an image and thermal intensifier and a microphone, and
21 the electro-optics is deployable after the accelerometer measures one of no
22 acceleration and vibration, and both no acceleration and vibration of the interior
23 module and exterior module.

24

1 14. The method of claim 13 wherein both the panning and tilting of the electro-
2 optics can be controlled wirelessly from a remote base station.

3

4 15. The method of any one of claims 2 to 14 wherein the interior module
5 comprises an acoustic sensor, a seismic sensor and a GPS to determine the acoustics
6 signals, seismic signals around the cargo and the final location of the cargo after the
7 interior module has been dropped onto the ground.

8

9 16. The method of any one of claims 2 to 15 wherein the energy absorption
10 structure comprises a carbon composite honeycomb structure and the interior module
11 comprises the cargo and an operating system;

12 the energy absorption structure is secured to an inner wall of the interior
13 module with screws and rubber grommets; and

14 the energy absorption structure is located between the inner wall of the interior
15 module and the cargo.

16

17 17. The method of any one of claims 9 to 16 wherein the interior module
18 comprises a cam attached to an unlatching servo-motor and a latch, and the tailfin
19 comprises a helical compression spring around the shaft, wherein the microprocessor
20 sends a signal to the unlatching servo-motor to activate the cam to release the latch,
21 and the tailfin separates from the exterior module with the assistance of the helical
22 compression spring which biases the tailfin away from the exterior module.

23

24 18. The method of any one of claims 2 to 17 wherein the nosecone comprises a
25 right half and a left half, the left half comprising a plurality of electromagnets; and

the right half and bottom of the exterior module comprising soft irons, and when the electromagnets are energized, the electromagnets and soft irons cooperate to secure the right half and the left half together and at the same time, secure the nosecone to the exterior module.

19. The method of claim 18 wherein the nosecone comprises a plurality of spring loaded solenoid plungers, wherein upon activation of the solenoid plungers with a command from the microprocessor in the nosecone, results in the solenoid plungers mechanically pushing the right half away from the left half.

20. The method of any one of claims 2 to 19 wherein the interior module comprises one of an added weight and an arrangement of the cargo so as to lower the centre of gravity of the exterior module to the lower half.

21. The method of claim 20 wherein the added weight is one of lead, battery and sand.

22. A system for delivering cargo from an aerial vehicle to a target area comprising, in combination:

a nosecone, a tailfin and an exterior module;

the exterior module having an interior module containing cargo and an energy absorbing structure to protect the cargo;

an energy absorption layer positioned between the exterior module and the interior module;

1 a triggering mechanism which separates the nosecone and tailfin from the
2 exterior module; and

3 wherein the exterior module has an upper half and a lower half, and an
4 exterior abrasion protection cover, and

5 the cargo is deployed above a predetermined height after the exterior module
6 has settled.

7

8 23. The system of claim 22 wherein the exterior module has a center of gravity at
9 the lower half.

10

11 24. The system of claims 22 or 23 wherein the energy absorption layer between
12 the exterior module and the interior module totally surrounds the interior module
13 except for an opening for a shaft of the tailfin.

14

15 25. The system of any one of claims 22 to 24 wherein the energy absorption layer
16 between the exterior module and the interior module comprises one of inflatable balls,
17 air bags, rubber or plastic grommets, sheets with shock absorbing and impact
18 resistance properties, and any combinations of the materials.

19

20 26. The system of any one of claims 22 to 25 wherein the exterior cover of the
21 exterior module is a zipped bag that comprises one of nylon, neoprene, plastic, kevlar
22 fabric, 200 denier Yarn, Vectran HS, softgoods, canvas, special polymers and any
23 combinations thereof.

24

1 27. The system of any one of claims 22 to 26 wherein the exterior module has an
2 egg-shaped cross section.

3

4 28. The system of any one of claims 22 to 27 wherein the nosecone is at the lower
5 half of the exterior module and the tailfin is at the upper half of the exterior module.

6

7 29. The system of any one of claims 22 to 28 wherein the nosecone comprises a
8 microprocessor and the interior module comprises a microprocessor.

9

10 30. The system of claim 29 wherein the nosecone further comprises a distance
11 sensor, and the distance sensor acts as part of the triggering mechanism, and the
12 nosecone and tailfin are separable from the exterior module when the distance sensor
13 senses that the system is at a predetermined altitude from the target area, a signal is
14 sent to the microprocessor in the nosecone and a wireless signal is sent to the
15 microprocessor in the interior module.

16

17 31. The system of any one of claims 22 to 30 further comprising a timer on the
18 nosecone and a timer in the interior module, wherein the nosecone and tailfin are
19 separable from the exterior module when the time of either timer reaches a certain
20 value after the system is deployed.

21

22 32. The system of any one of claims 22 to 31 wherein upon contact with the target
23 area, the exterior module bounces prior to settling generally in the upright position.

24

1 33. The system of any one of claims 22 to 32 wherein the interior module
2 comprises an accelerometer which measures acceleration and/or vibration of the
3 interior module and exterior module, and the cargo comprises electro-optics such as a
4 video camera with or without an image and thermal intensifier and a microphone, and
5 the electro-optics is deployable after the accelerometer measures one of no
6 acceleration and vibration, and both no acceleration and vibration of the interior and
7 exterior modules.

8
9 34. The system of claim 33 wherein both the panning and tilting of the electro-
10 optics can be controlled wirelessly from a remote base station.

11
12 35. The system of any one of claims 22 to 34 wherein the interior module
13 comprises an acoustic sensor, a seismic sensor and a GPS to determine the acoustic
14 signals, seismic signals around the cargo and the final location of the cargo after the
15 interior module has been dropped onto the ground.

16
17 36. The system of any one of claims 22 to 35 wherein the energy
18 absorption structure comprises a carbon composite honeycomb structure and the
19 interior module comprises the cargo and an operating system;

20 the energy absorption structure is secured to an inner wall of the
21 interior module with screws and rubber grommets; and

22 the energy absorption structure is located between the inner wall of the
23 interior module and the cargo.

24

1 37. The system of any one of claims 30 to 36 wherein the interior module
2 comprises a cam attached to an unlatching servo-motor and a latch, and the tailfin
3 comprises a helical compression spring around the shaft, wherein the microprocessor
4 sends a signal to the unlatching servo-motor to activate the cam to release the latch,
5 and the tailfin separates from the exterior module with the assistance of the helical
6 compression spring which biases the tailfin away from the exterior module.

7

8 38. The system of any one of claims 22 to 37 wherein the nosecone comprises a
9 right half and a left half, the left half comprising a plurality of electromagnets; the
10 right half and bottom of the exterior module comprising soft irons, and when the
11 electromagnets are energized, the electromagnets and soft irons cooperate to secure
12 the right half and the left half together and at the same time, secure the nosecone to
13 the exterior module.

14

15 39. The system of claim 38 wherein the nosecone comprises a plurality of spring
16 loaded solenoid plungers, wherein upon activation of the solenoid plungers with a
17 command from the microprocessor in the nosecone, results in the solenoid plungers
18 mechanically pushing the right half away from the left half.

19

20 40. The system of any one of claims 22 to 39 wherein the interior module
21 comprises one of an added weight and an arrangement of the cargo so as to lower the
22 centre of gravity of the exterior module to the lower half.

23

24 41. The system of claim 40 wherein the added weight is one of lead, battery and
25 sand.

1

2 42. The system of any one of claims 22 to 41 wherein the external module
3 dropped is a node of a multi-node wireless sensor network when a plurality of
4 external modules are dropped in an area.

5

6 43. The system of claim 42 wherein an identification of the node, a latitude and
7 longitude of the node, an azimuth of the direction of view of the electro-optics are
8 transmitted wirelessly to the remote base station.

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