

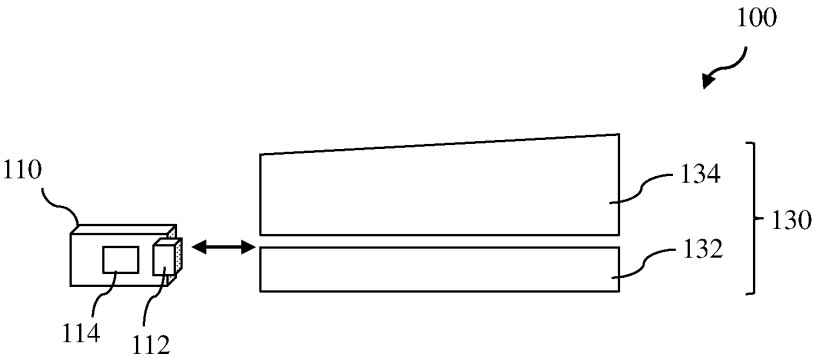


FIG. 1

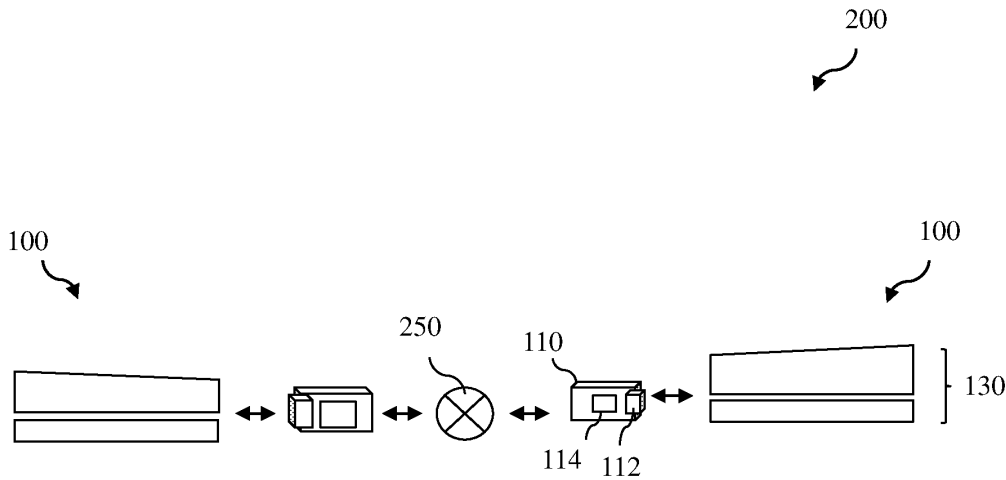
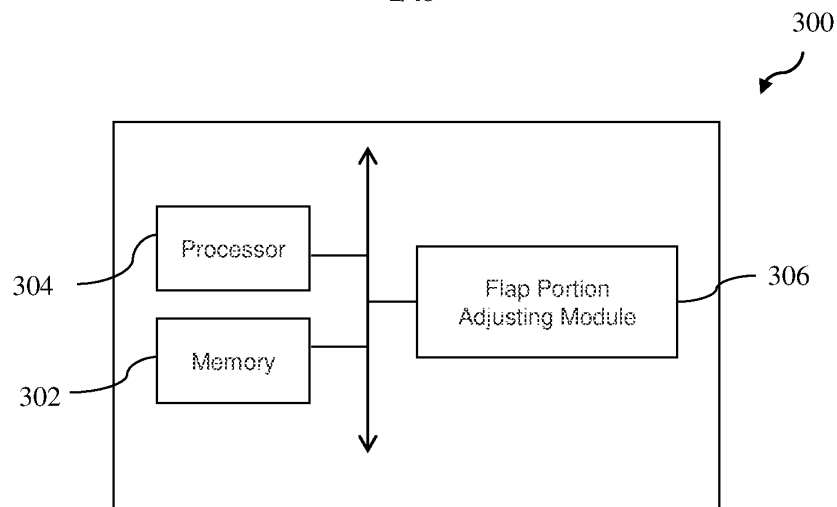
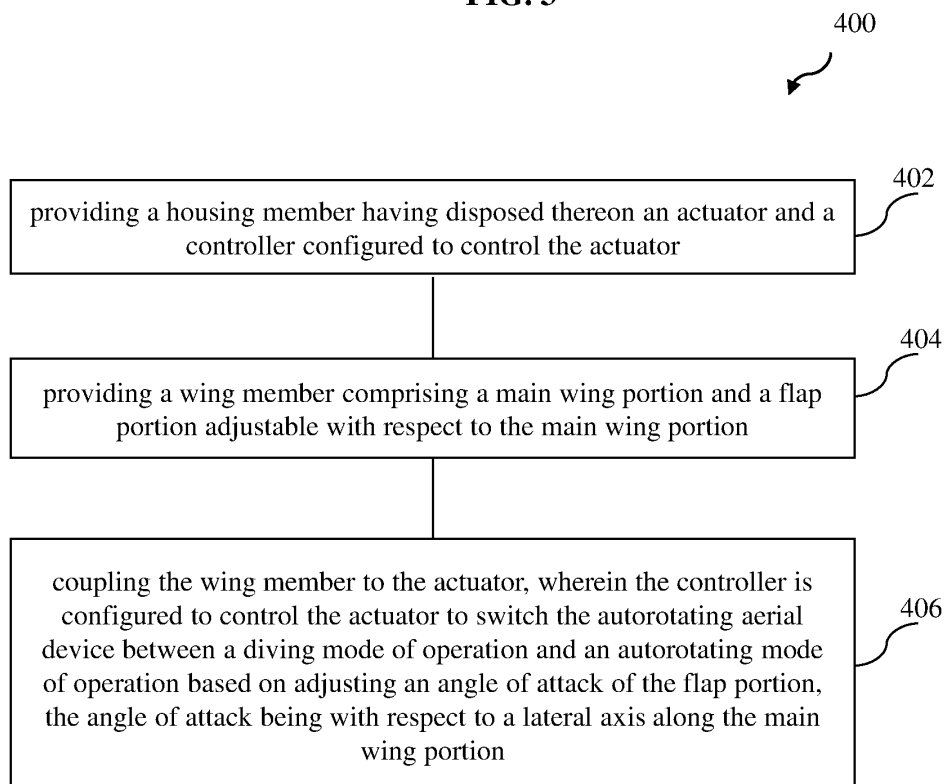


FIG. 2

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**FIG. 3****FIG. 4**

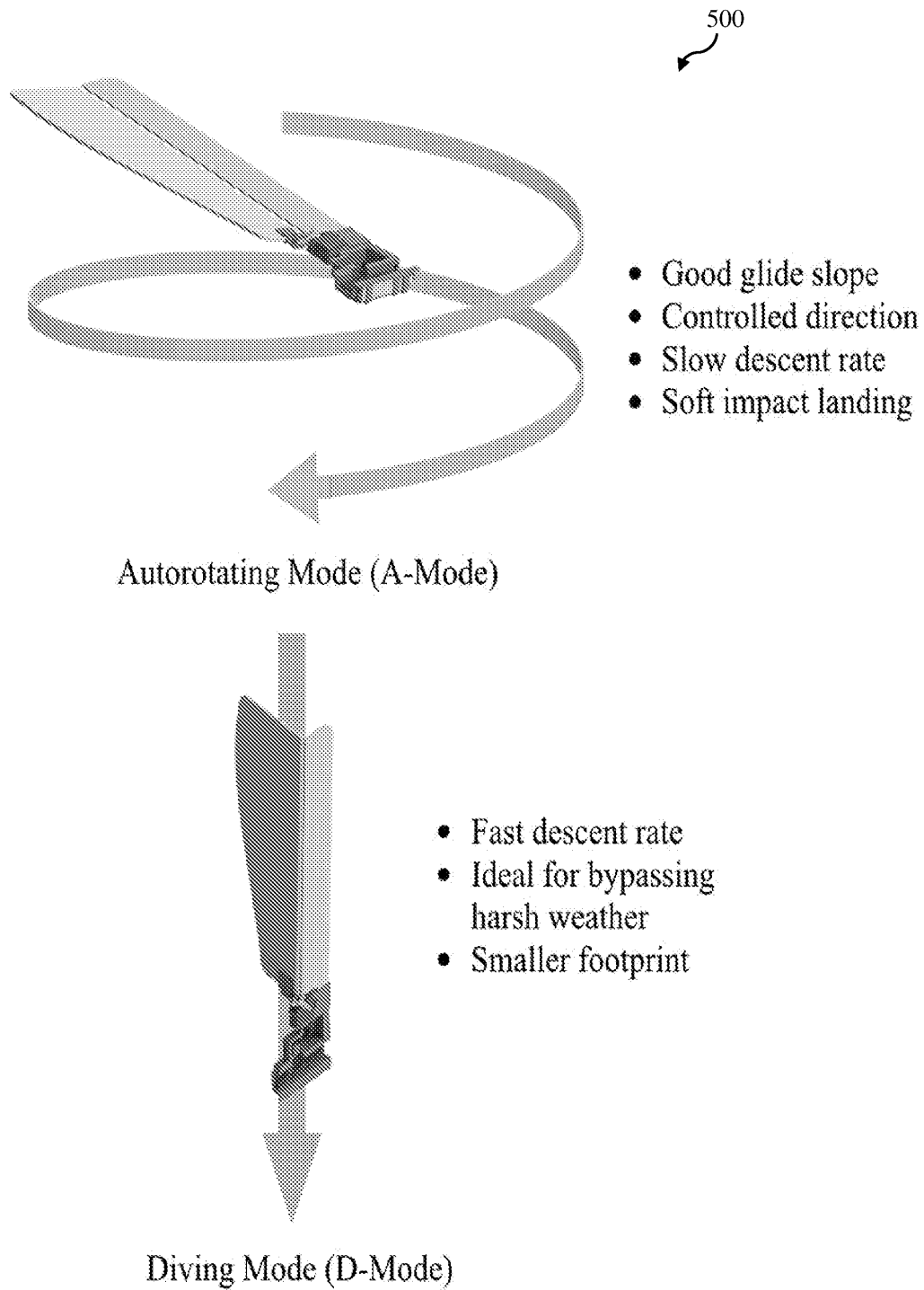


FIG. 5A

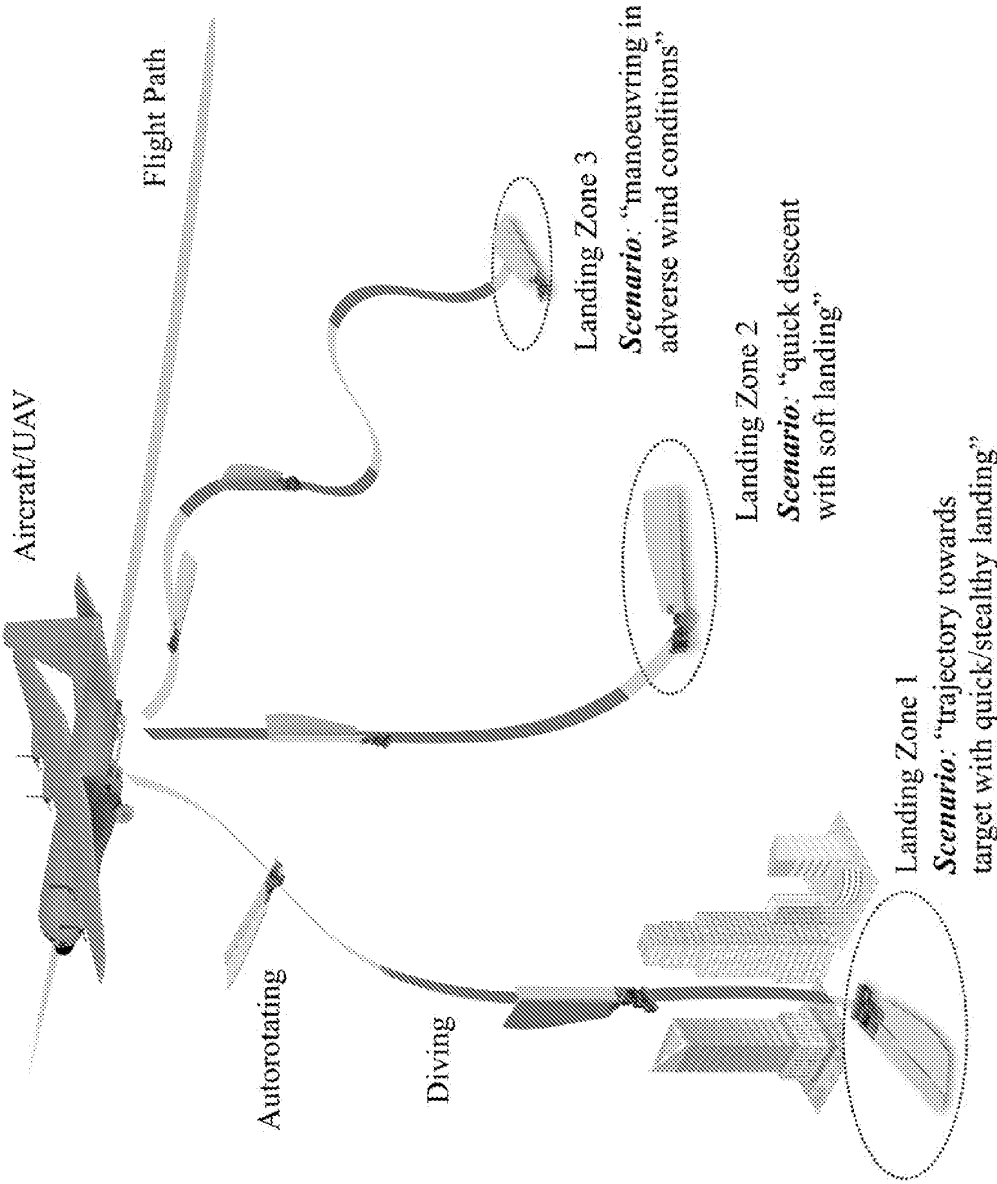


FIG. 5B

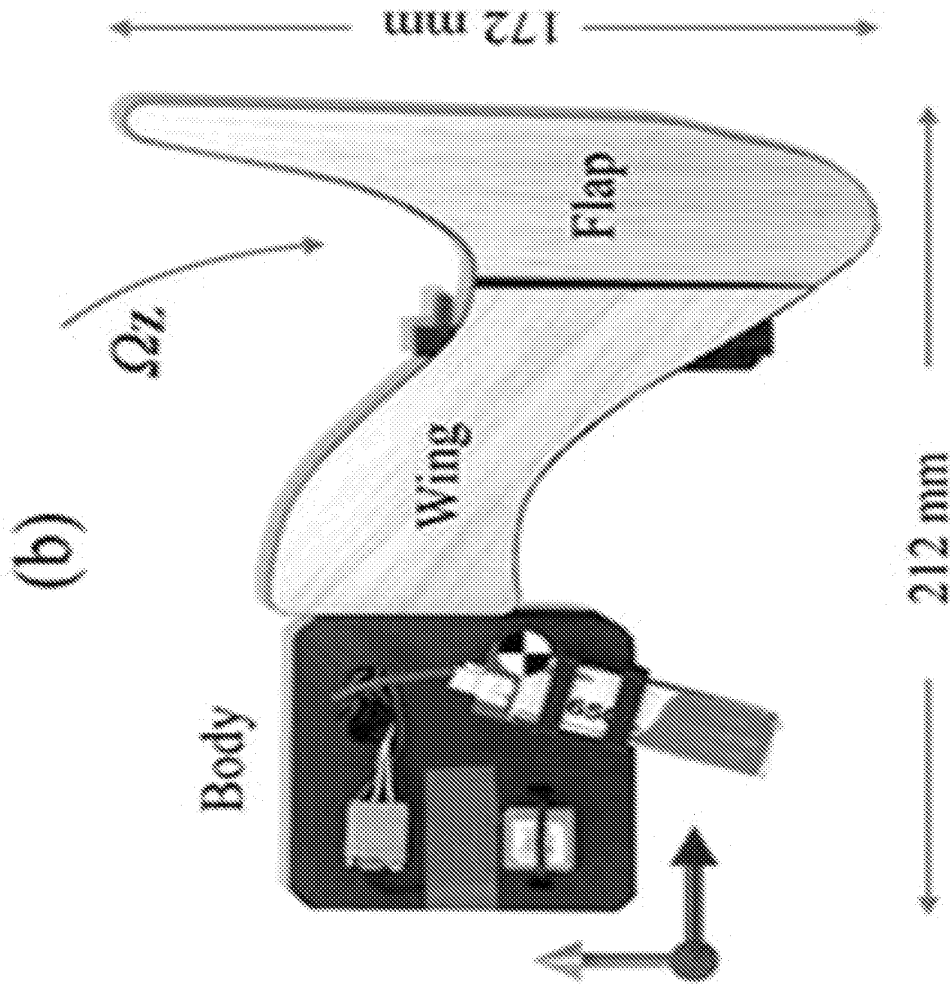


FIG. 5C

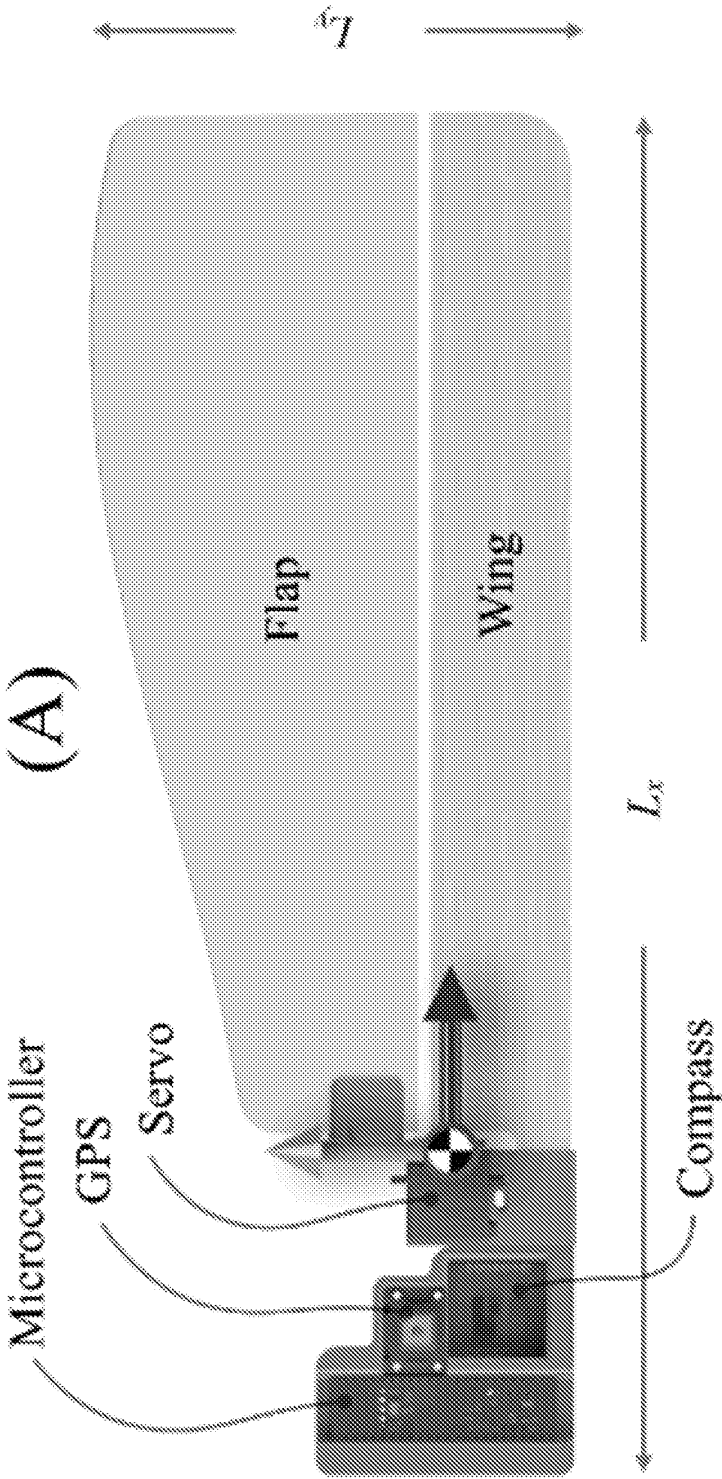


FIG. 6A

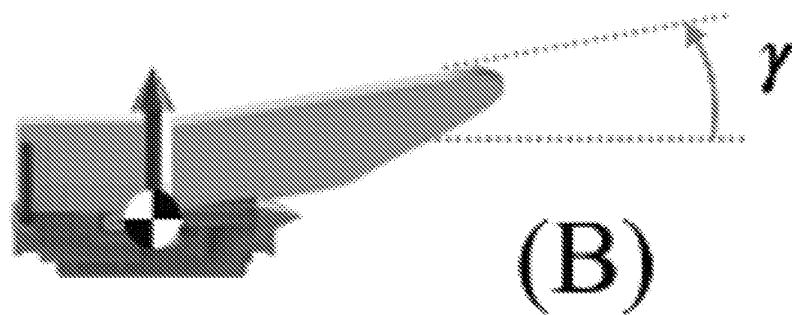


FIG. 6B

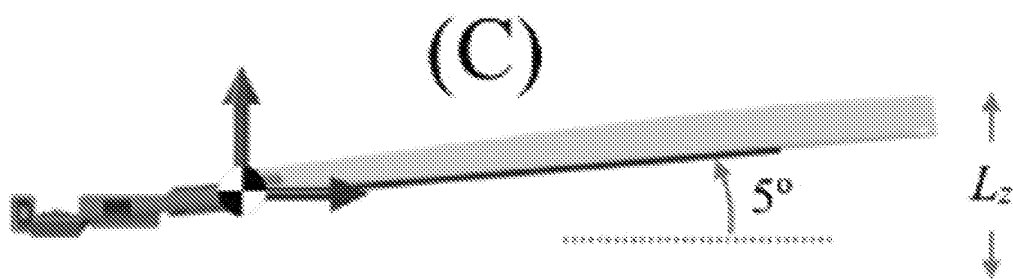


FIG. 6C

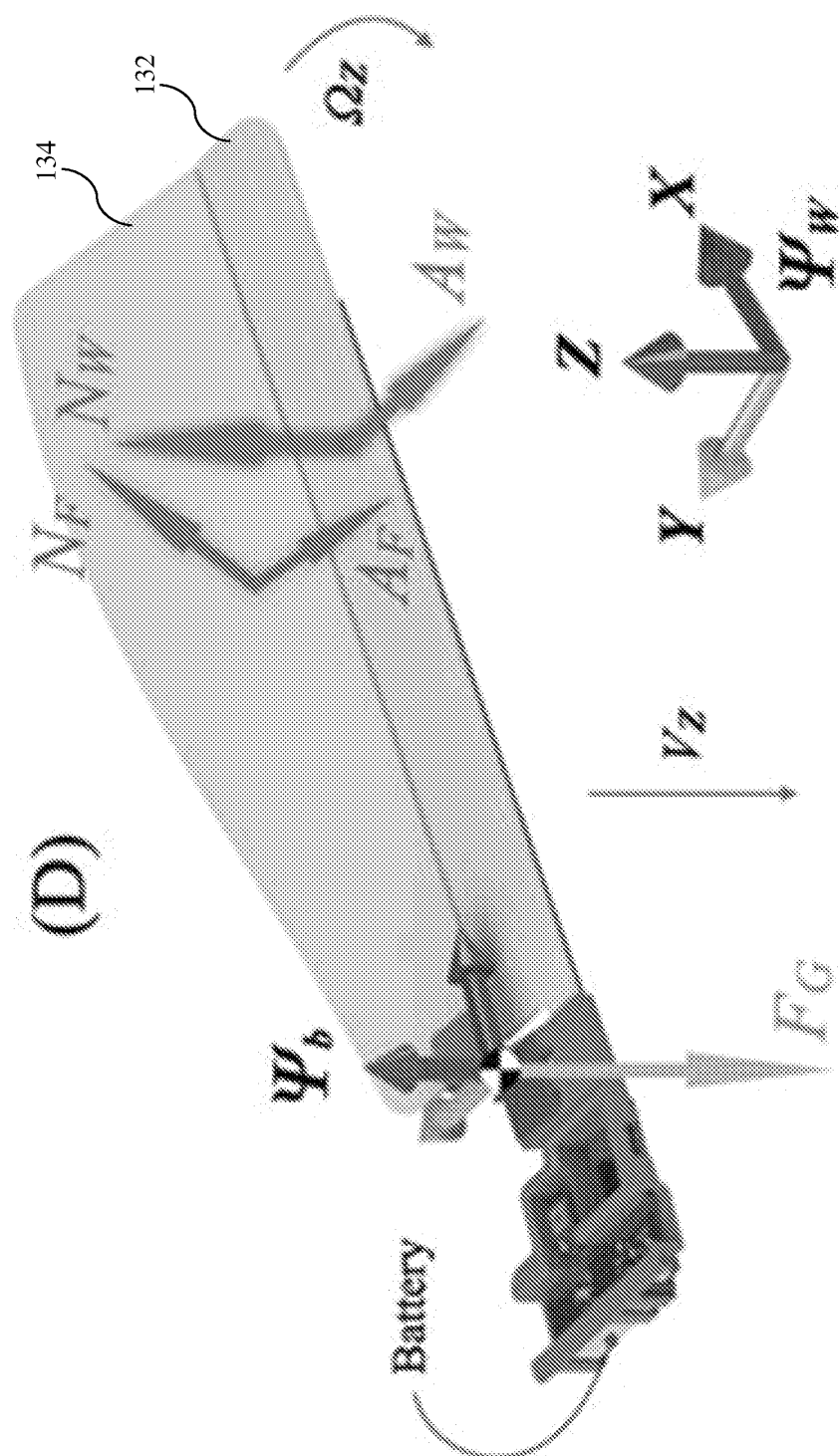


FIG. 6D

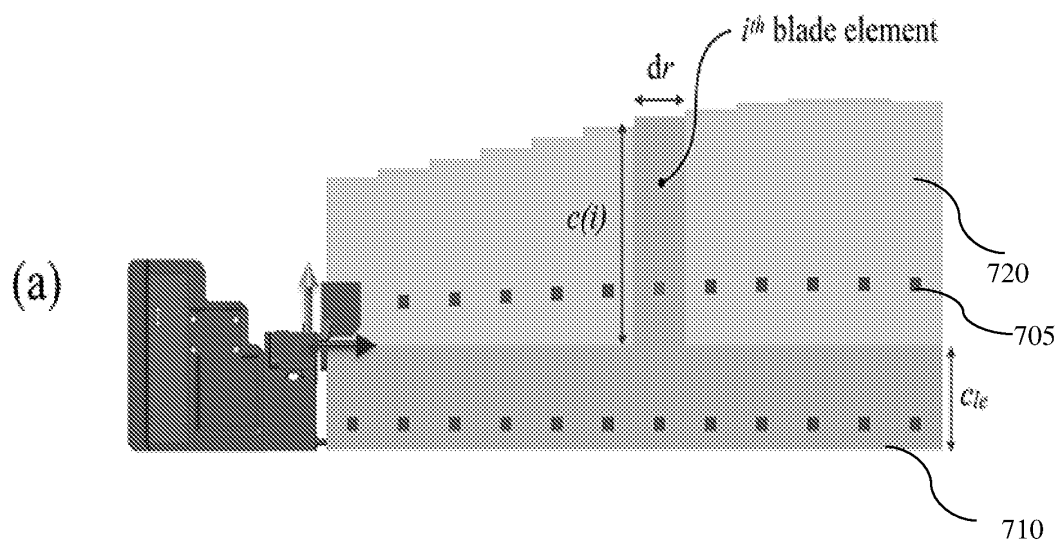


FIG. 7A

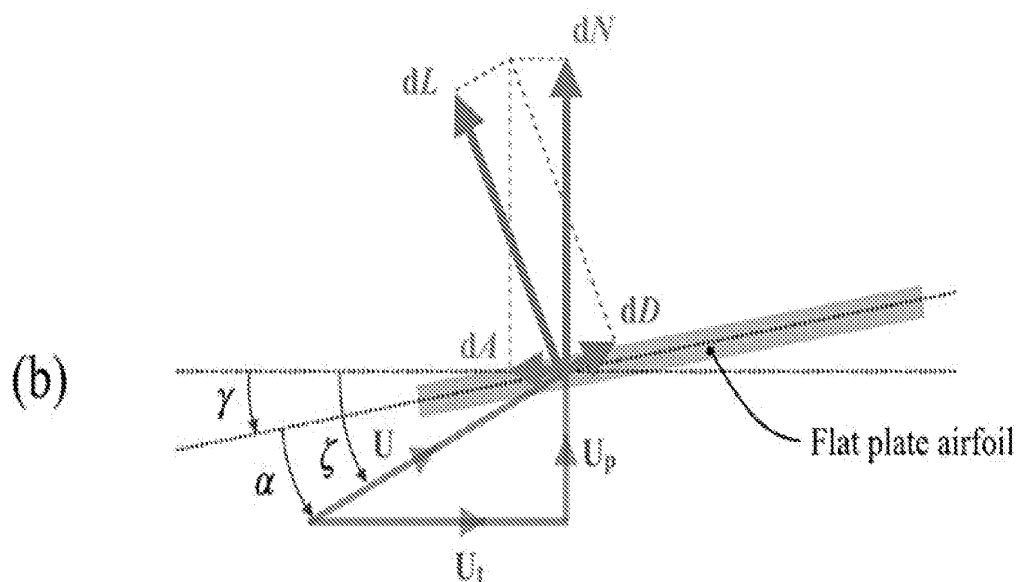


FIG. 7B

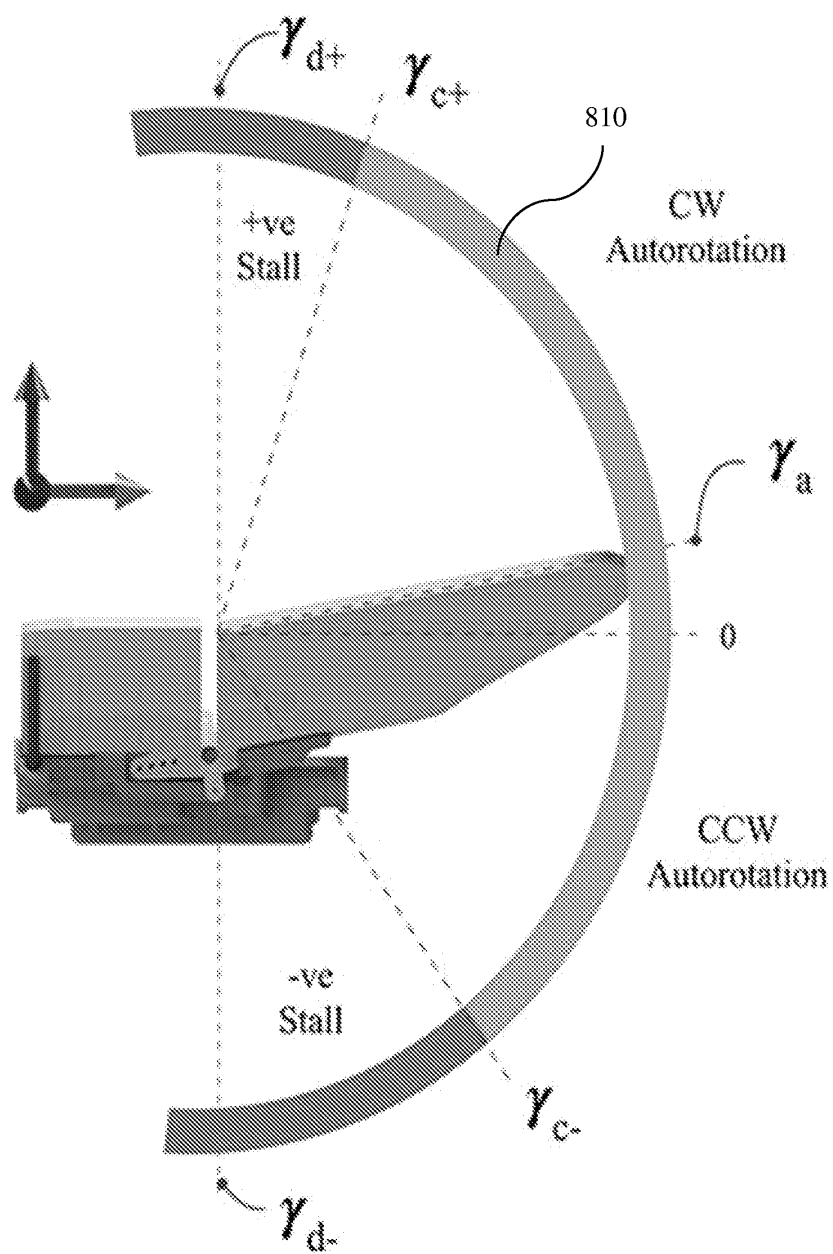


FIG. 8

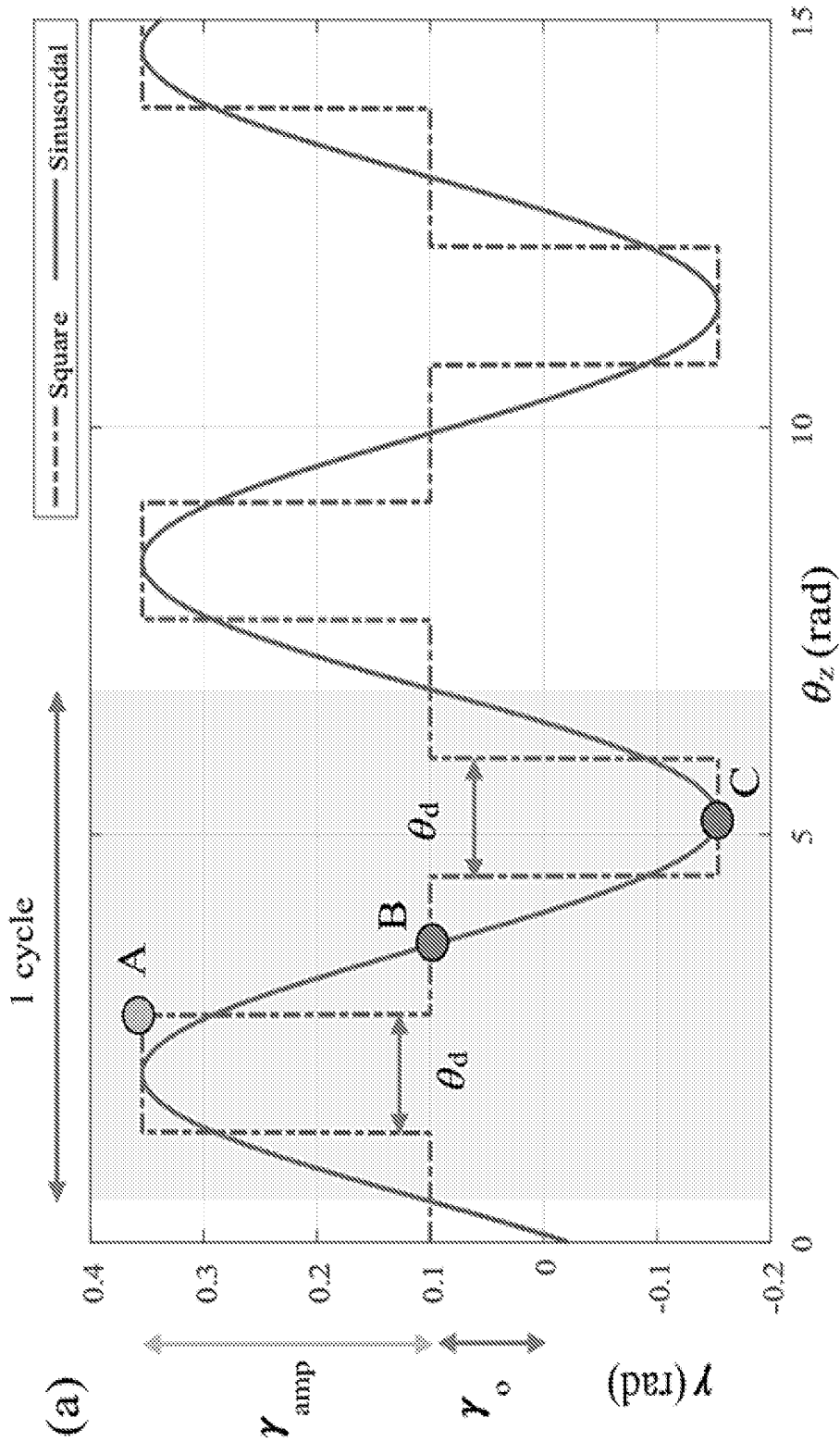


FIG. 9A

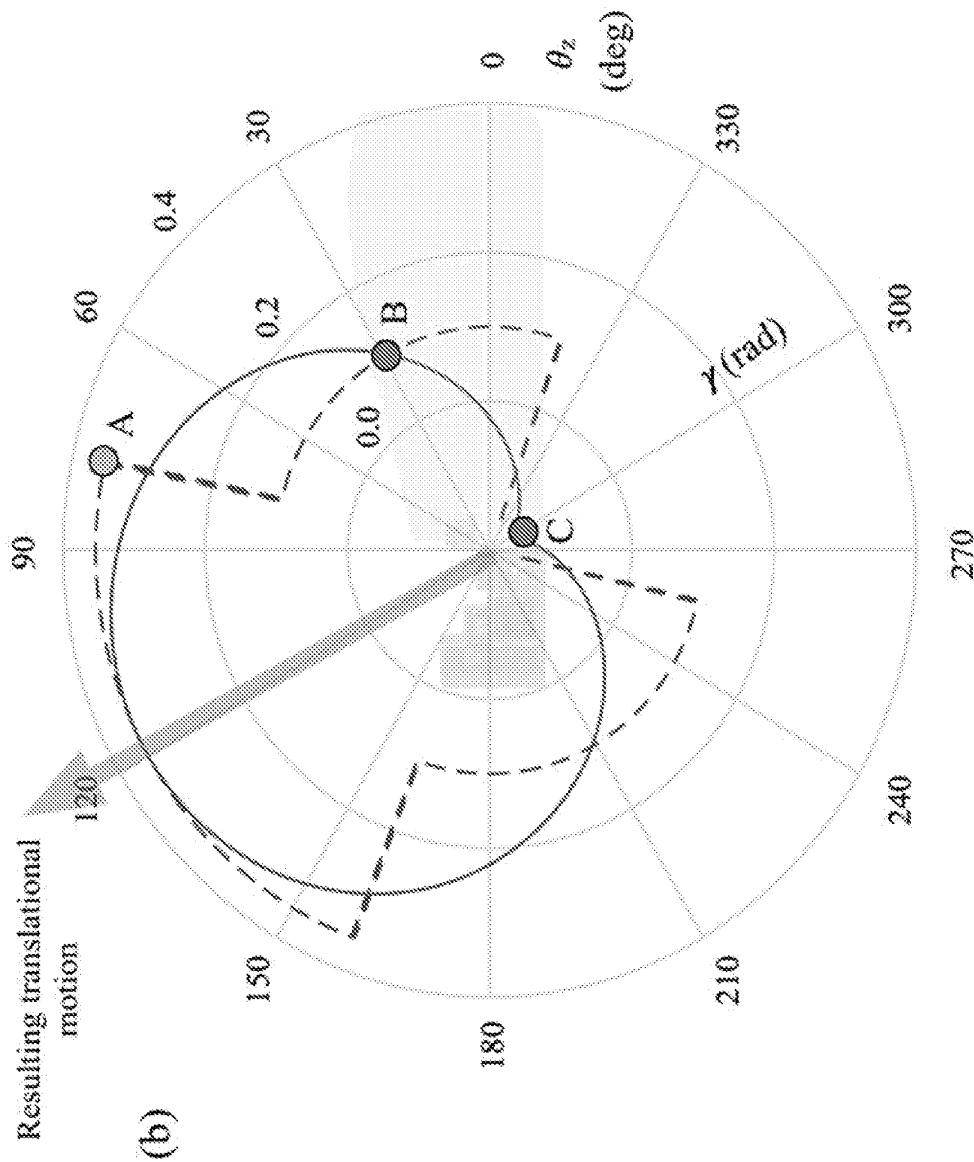


FIG. 9B

Table 3
TABLE OF SIMULATION PARAMETERS

PARAMETERS	
Environment	$\rho_{air} = 1.225\text{kg/m}^3, g = -9.81\text{m/s}$
Initial conditions	$V_Z = 0\text{m/s}, \Omega_Z = -18.8\text{rad/s}$
Objective fn coeffs	$\kappa_1 = 100, \kappa_2 = 500, \kappa_3 = 200, \kappa_4 = 1$ $\beta_1 = 1, \beta_2 = 10, \beta_3 = 400$
Others	$n_1 = 3000, n_2 = 40000, t_s = 0\text{s}, t_f = 40\text{s}$ $n_3 = 10000, n_4 = 40000, t_{s2} = 10\text{s}, t_{f2} = 40\text{s}$ $n_{be} = 12, c_{min} = 30\text{mm}, c_{max} = 120\text{mm}$
OPTIMIZED DESIGN VARIABLES	
Polynomial coeffs	$C_1 = -0.0325, C_2 = 0.4175, C_3 = 2.1997,$ $C_4 = 58.5336$
Chord lengths (mm)	$c_1 = 61.1, c_2 = 64.3, c_3 = 68.0, c_4 = 71.9$ $c_5 = 75.9, c_6 = 79.7, c_7 = 83.2, c_8 = 86.2$ $c_9 = 88.5, c_{10} = 89.8, c_{11} = 90.0, c_{12} = 88.9$
Radius (mm)	$dr = 23, R = 276$
Others	$\gamma_a = 0.1887\text{rad}, m = 58\text{g}$ $L_x = 368\text{mm}, L_y = 131\text{mm}, L_z = 44\text{mm}$
OPTIMIZED CONTROL VARIABLES	
Control vars	$\gamma_o = -0.1345, \epsilon = 0.2010, \gamma_{amp} = 0.1188$
Others	$\lambda_c = 0$

FIG. 10

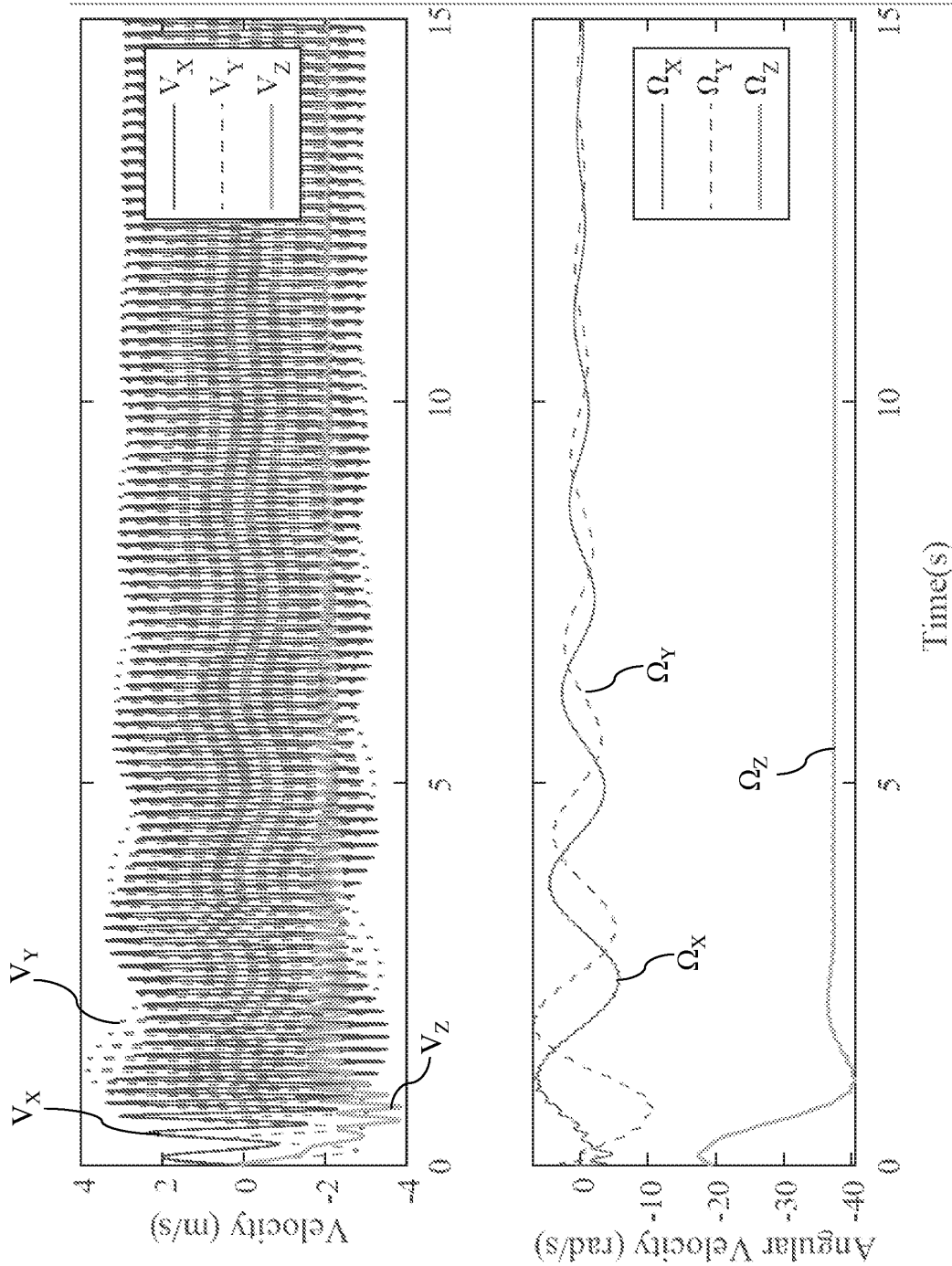


FIG. 11

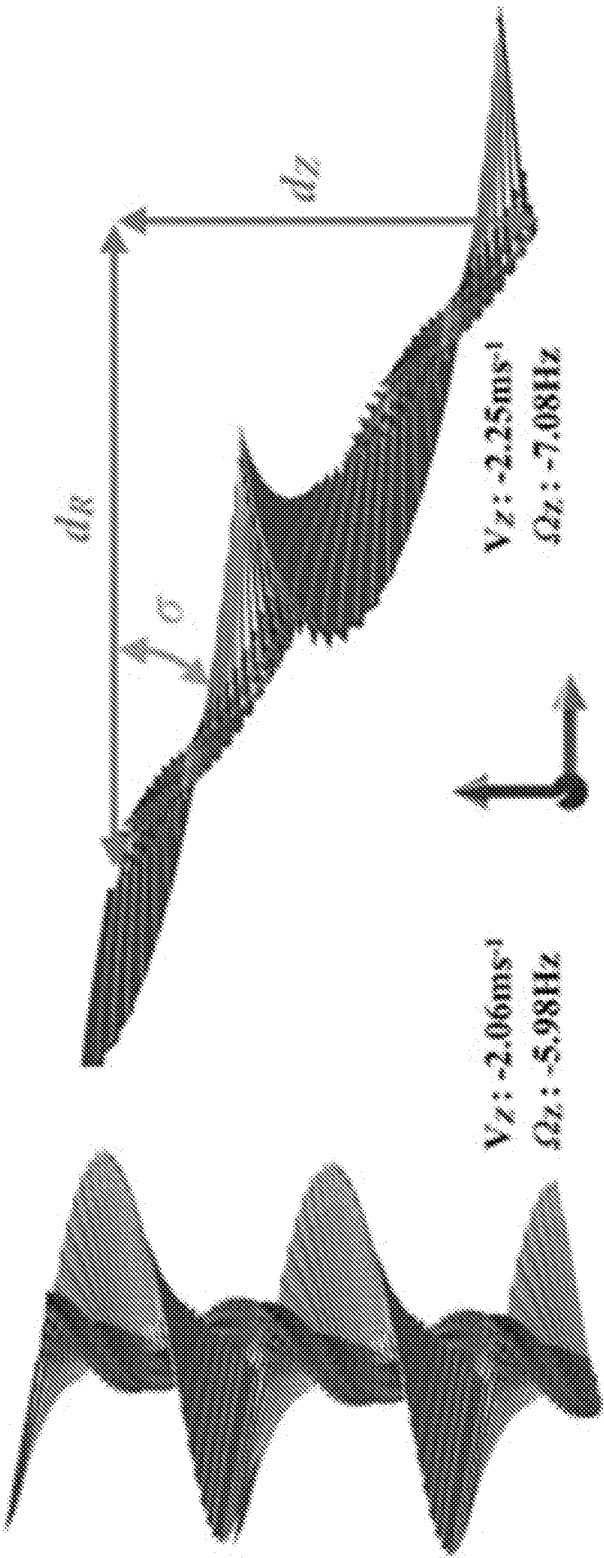


FIG. 12

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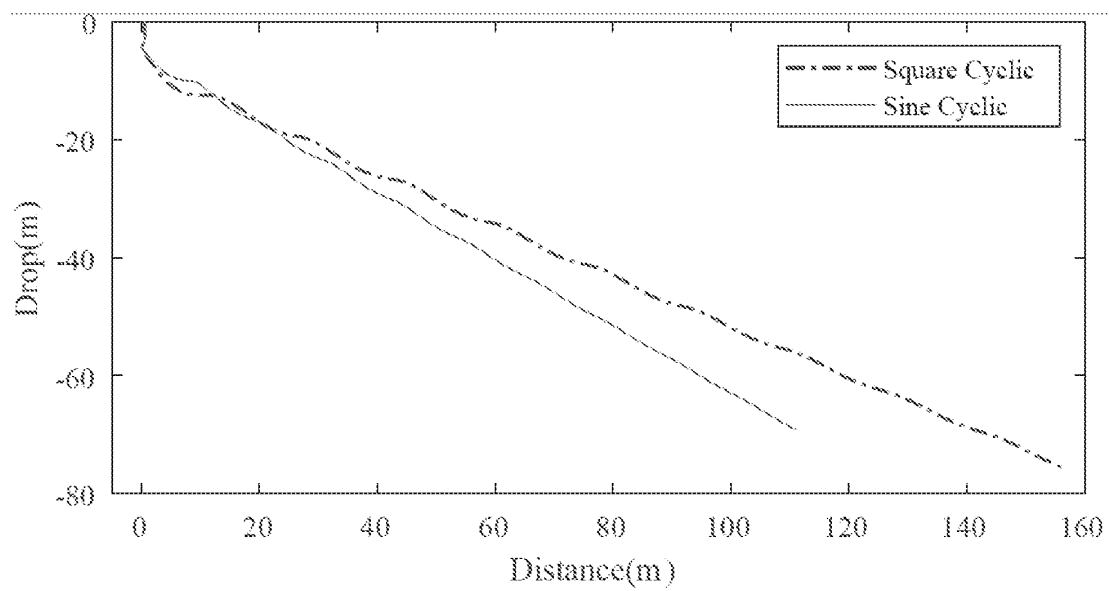


FIG. 13A

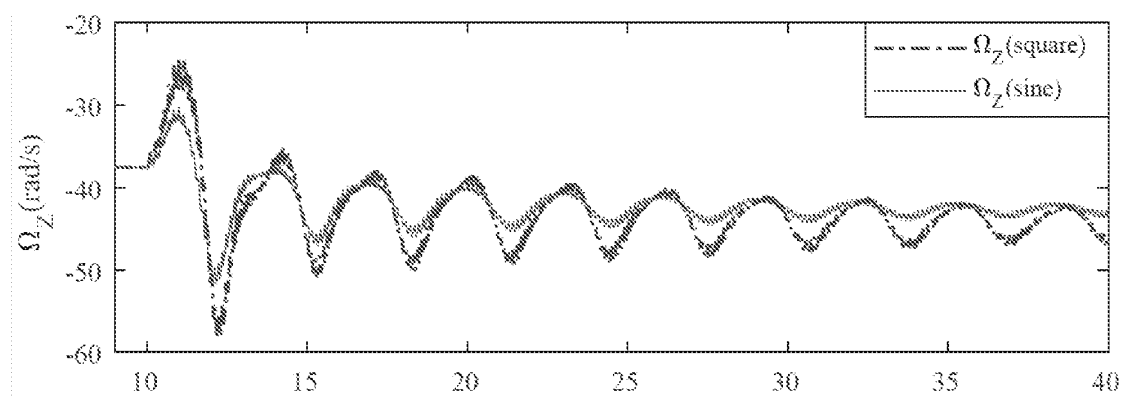


FIG. 13B

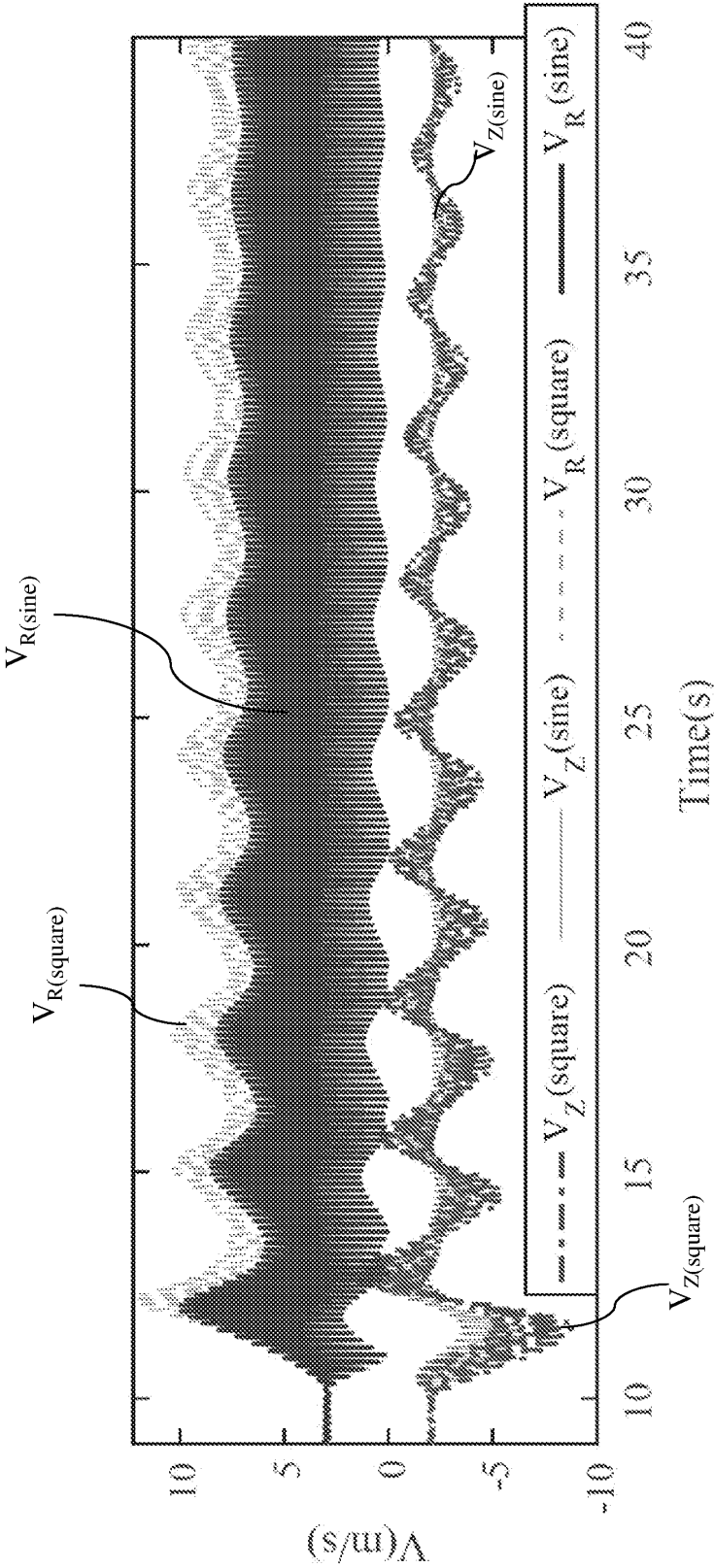


FIG. 13C

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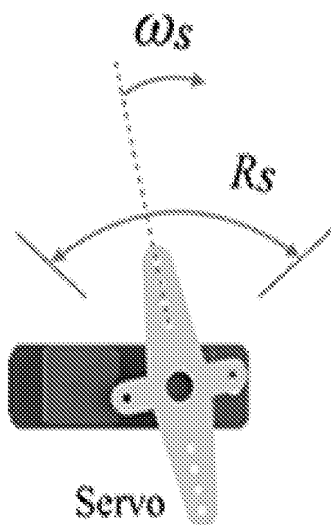


FIG. 14A

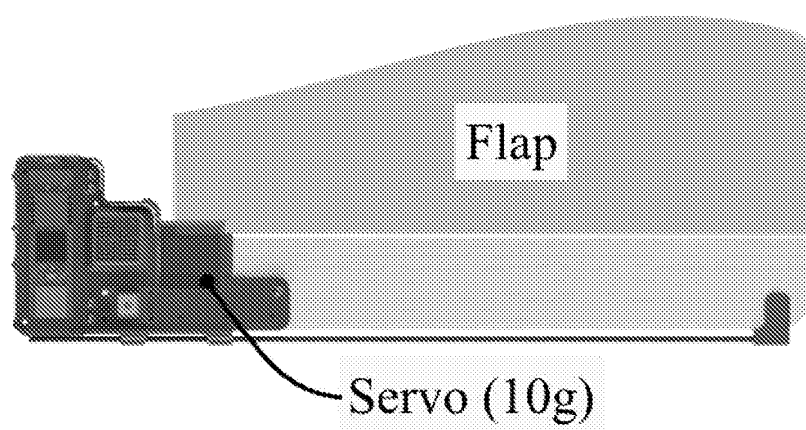


FIG. 14B

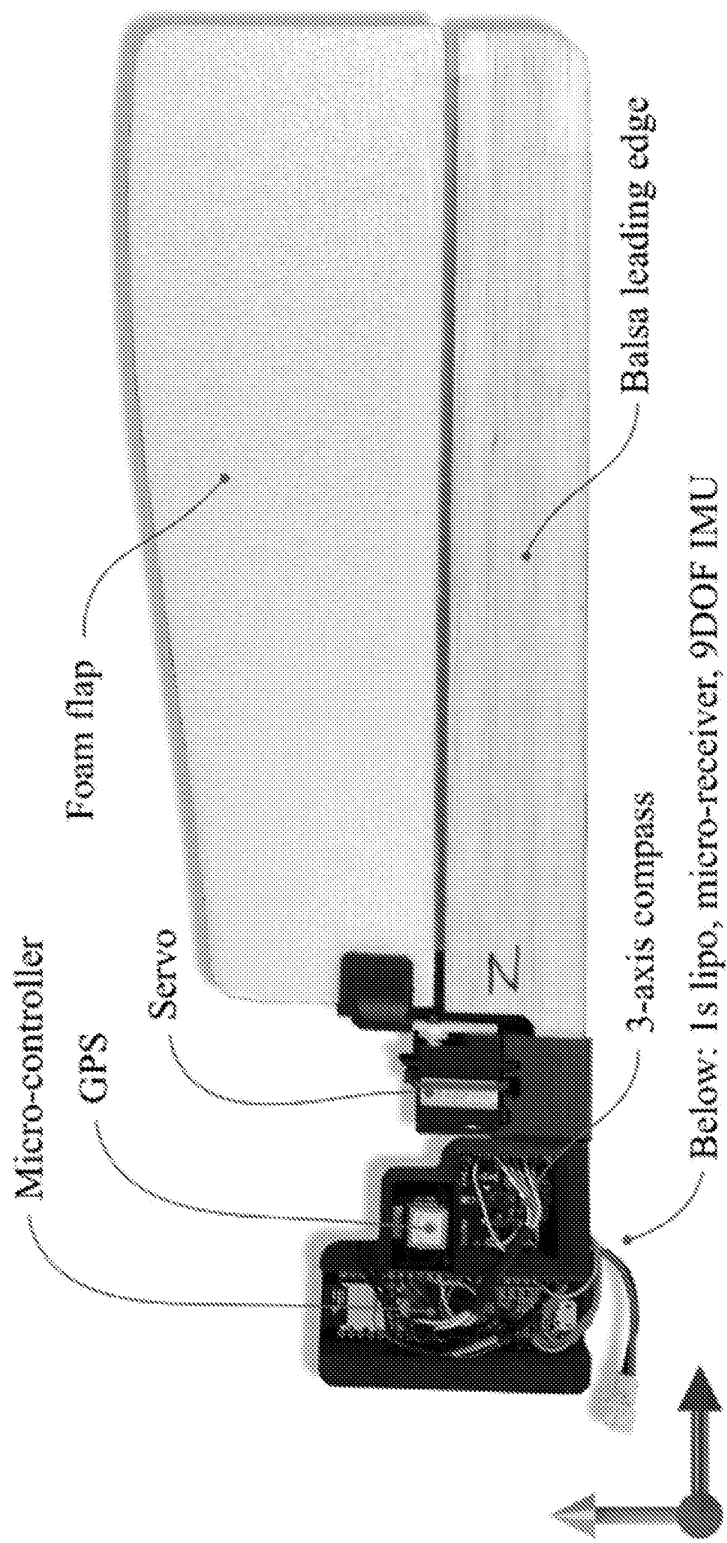


FIG. 14C

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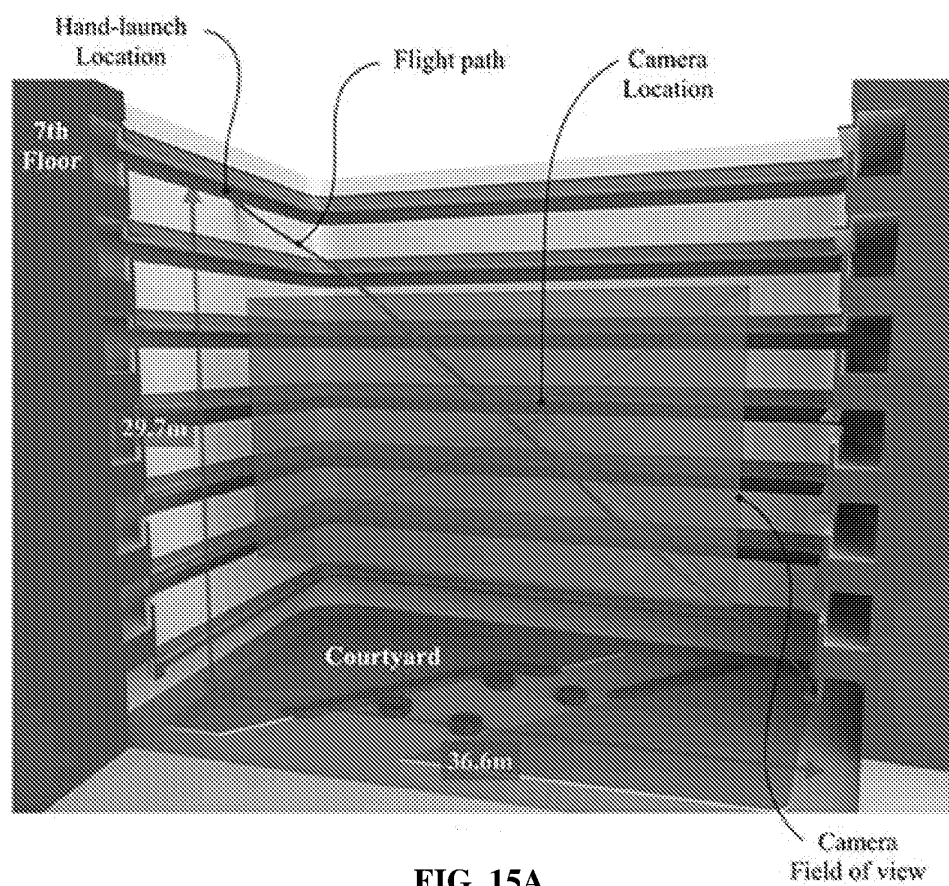


FIG. 15A

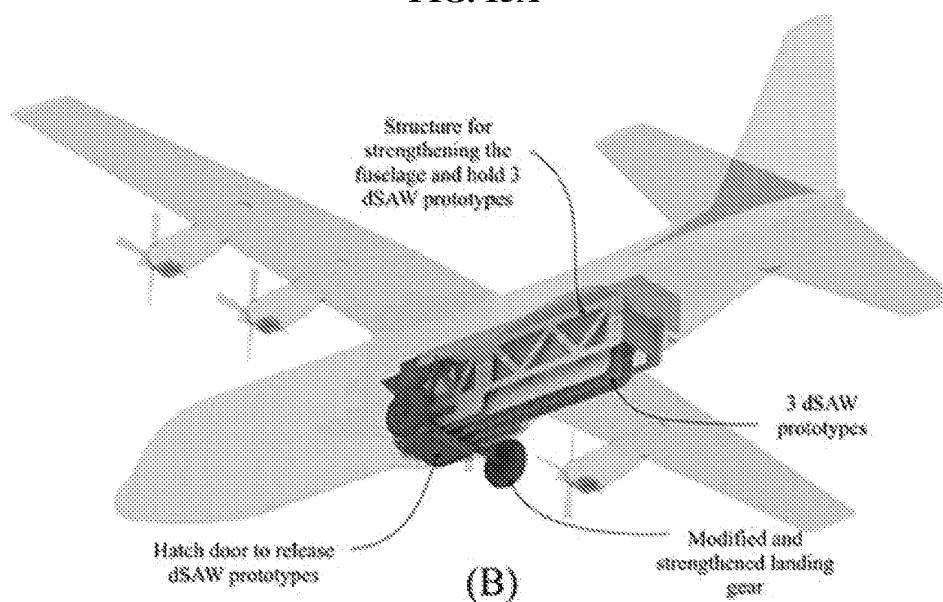
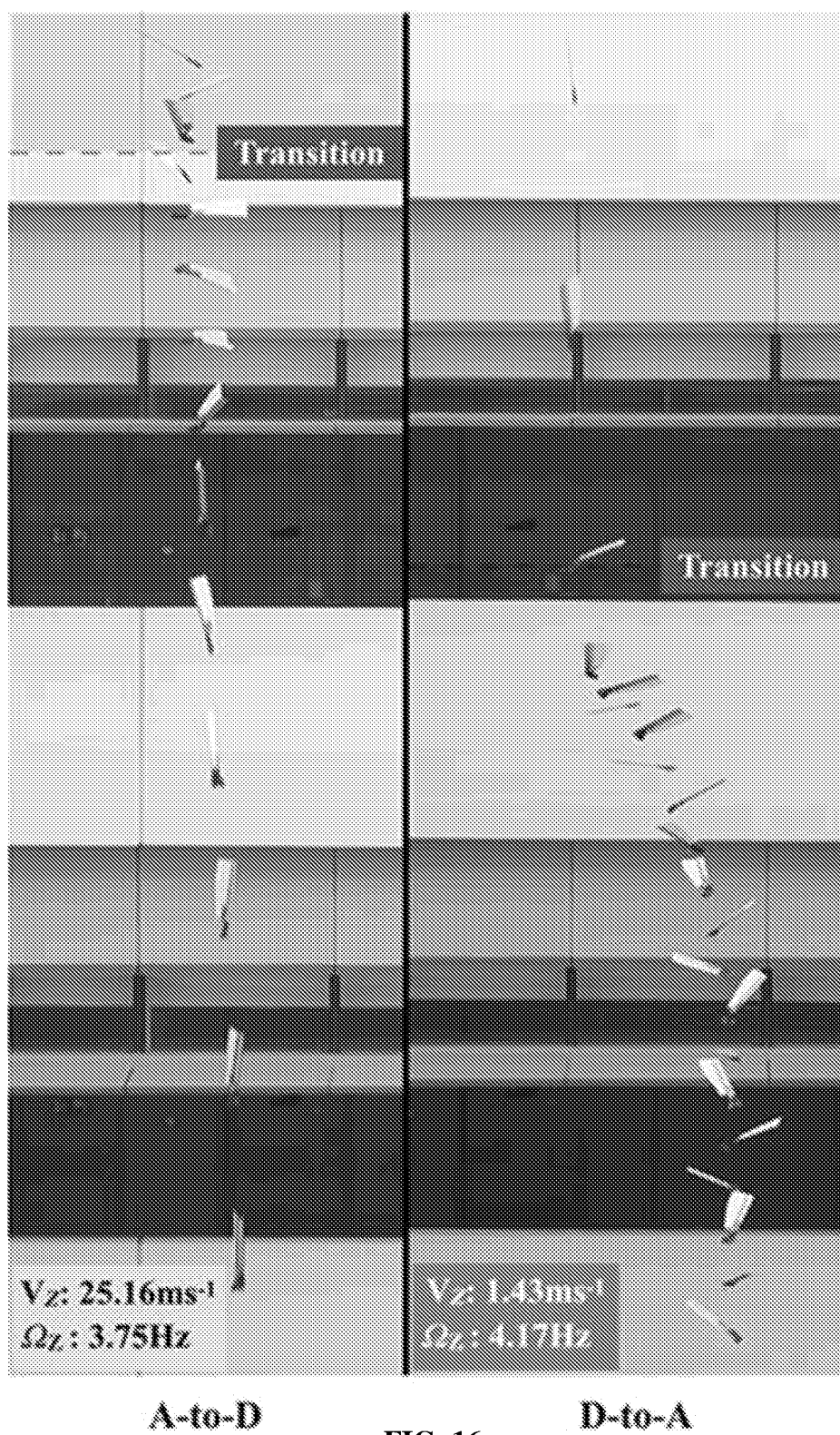


FIG. 15B



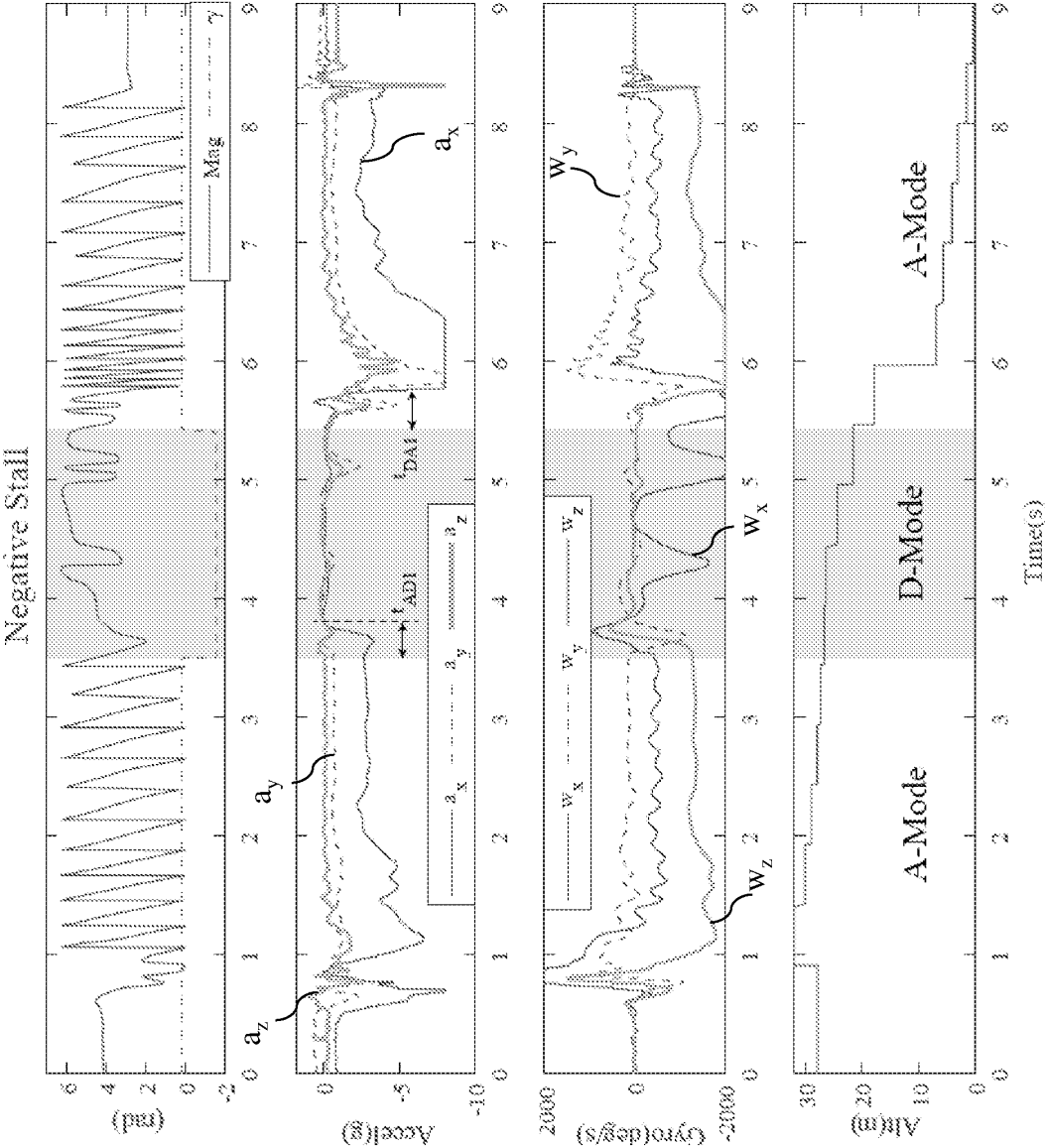


FIG. 17A

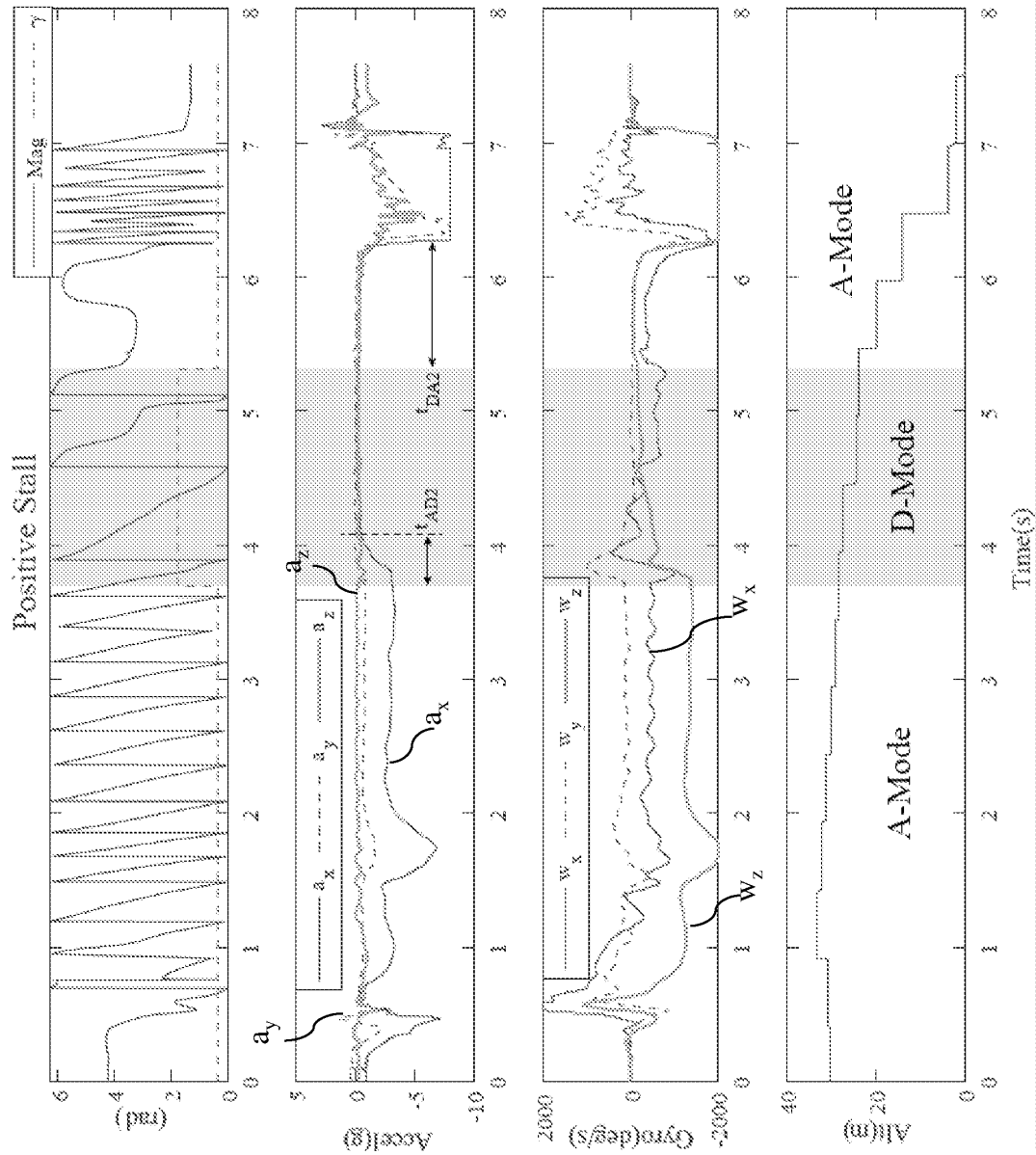


FIG. 17B



FIG. 18

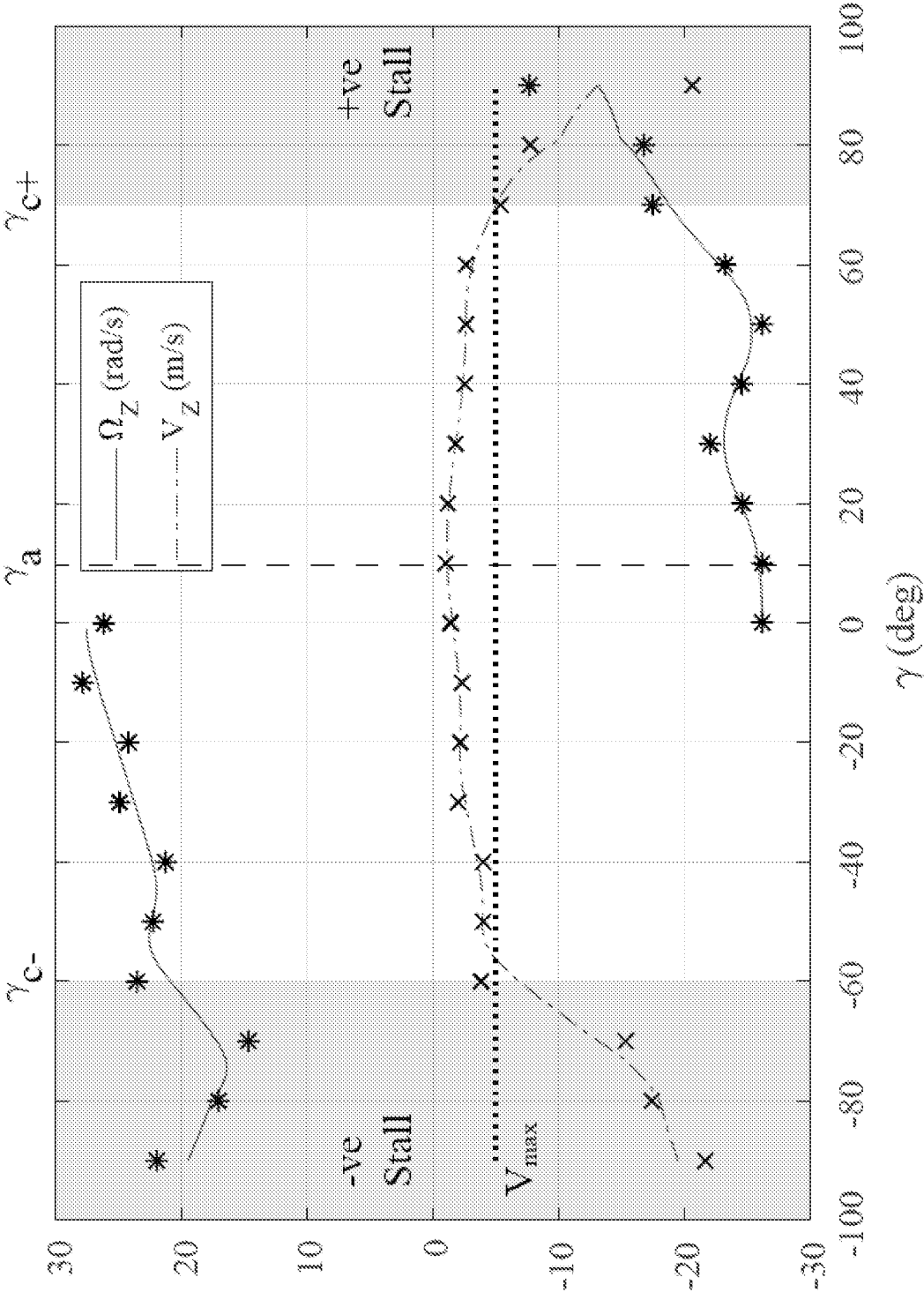


FIG. 19

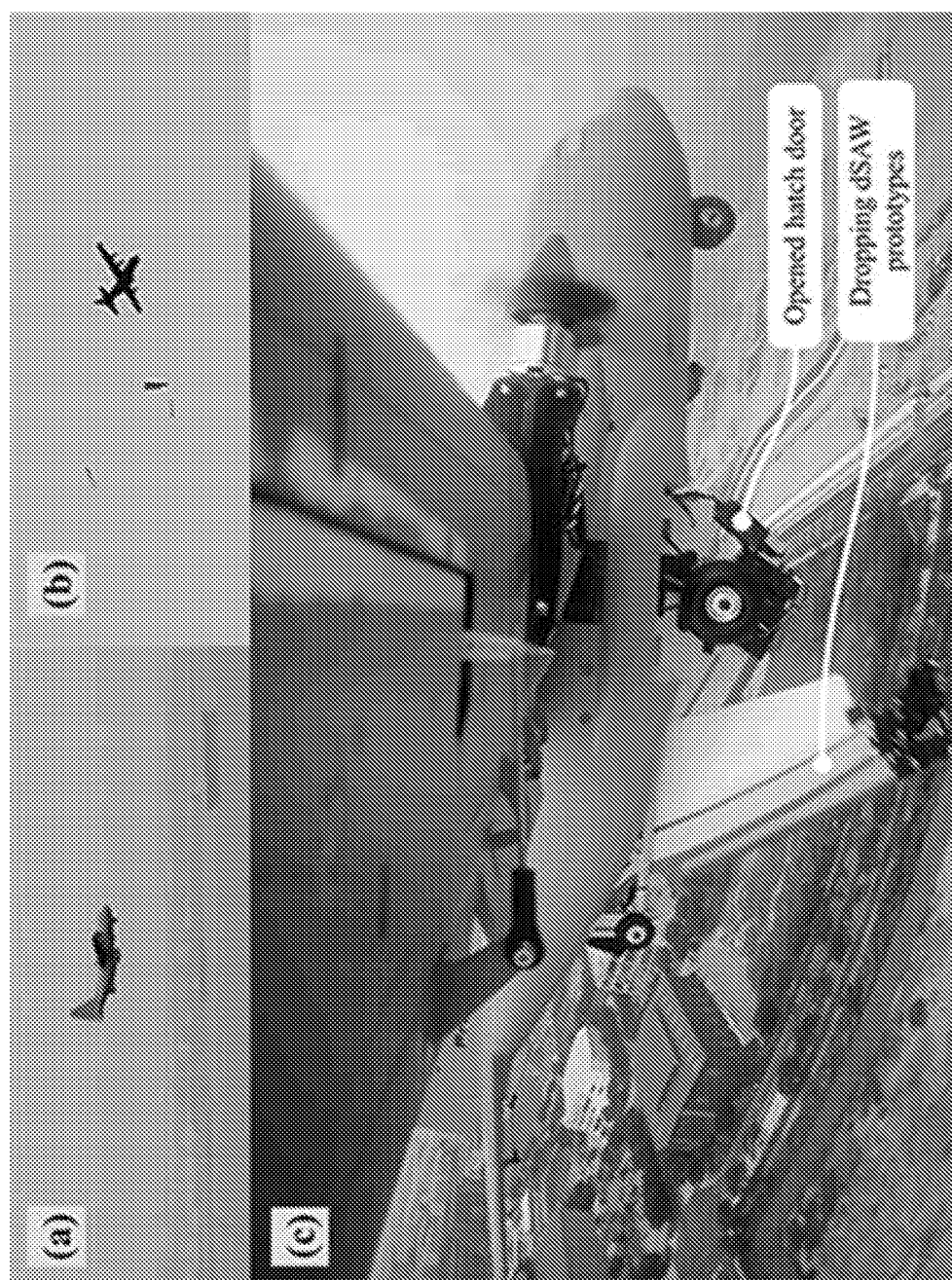


FIG. 20

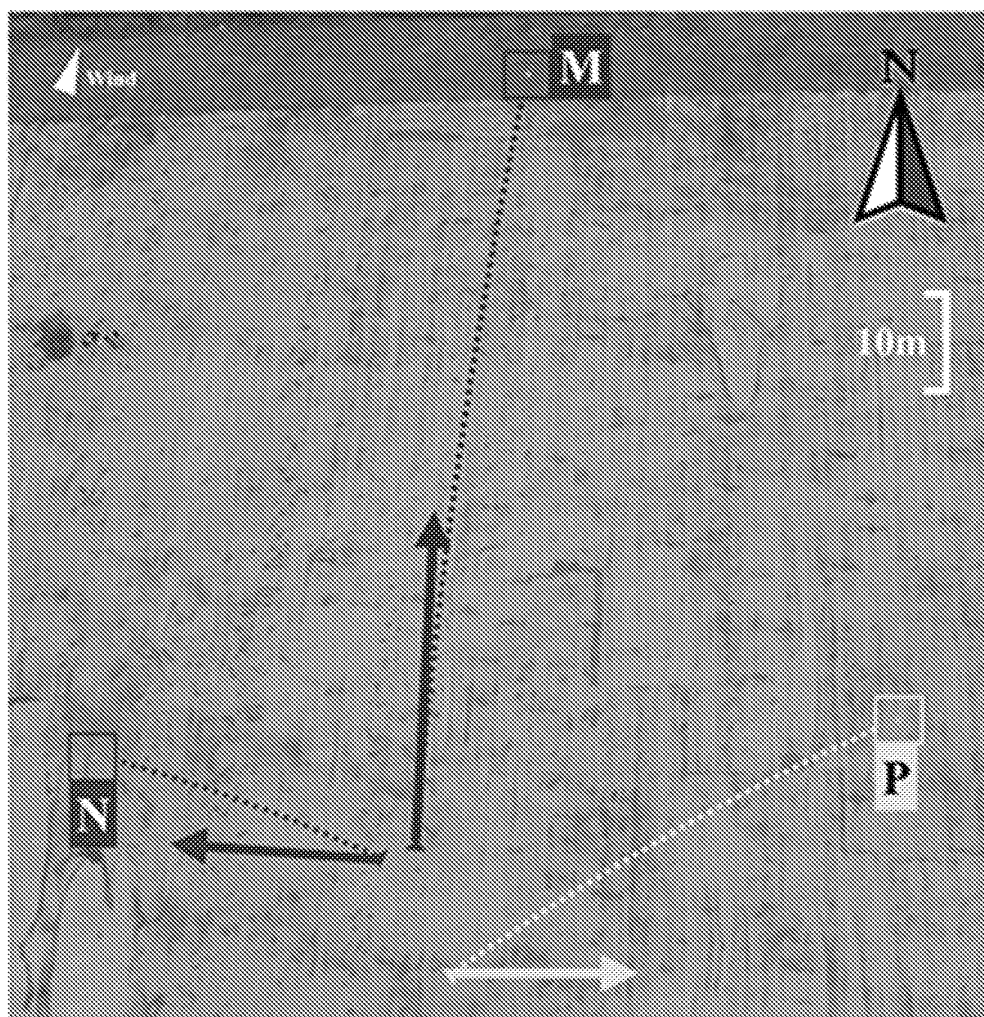


FIG. 21

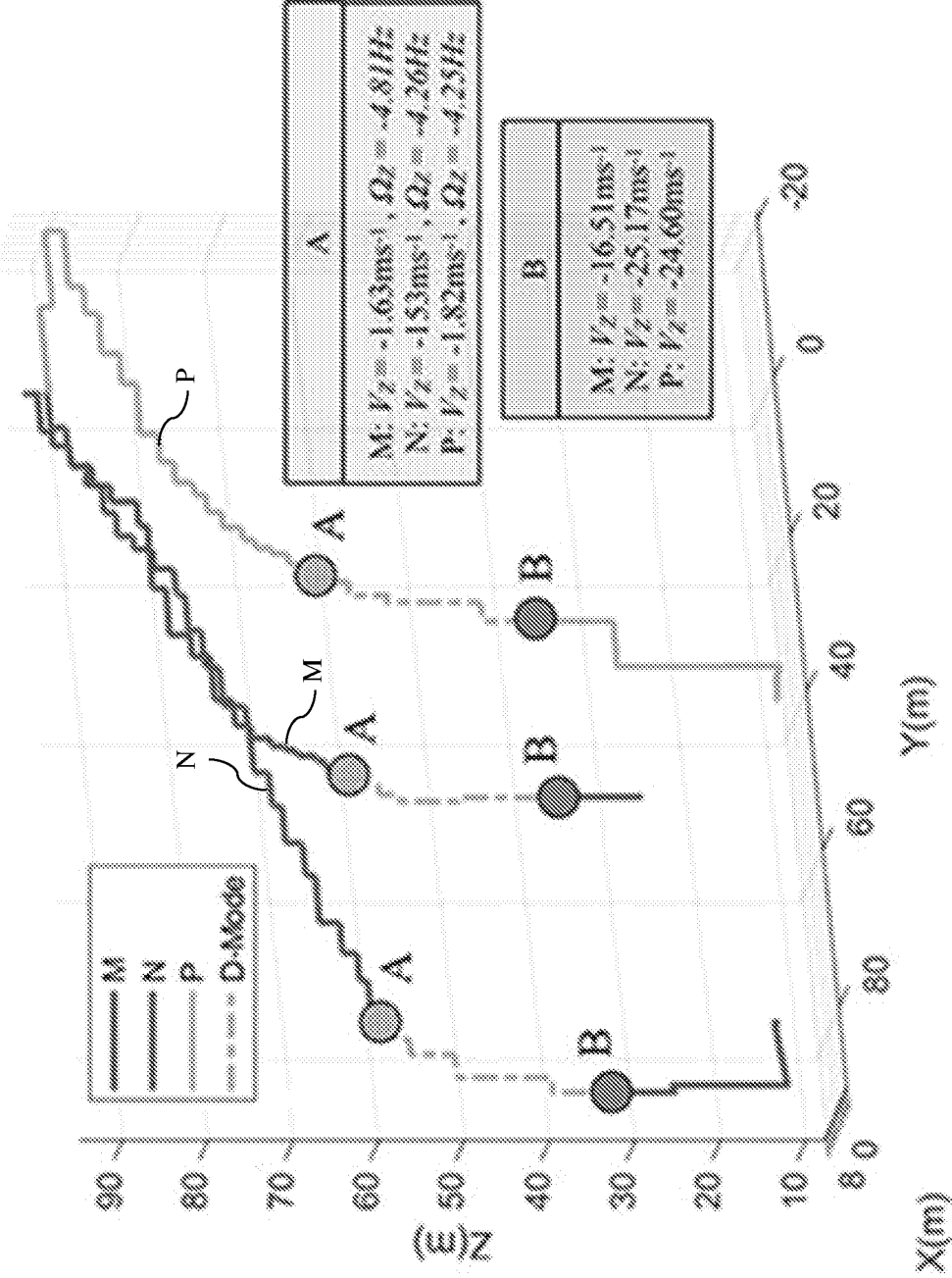


FIG. 22

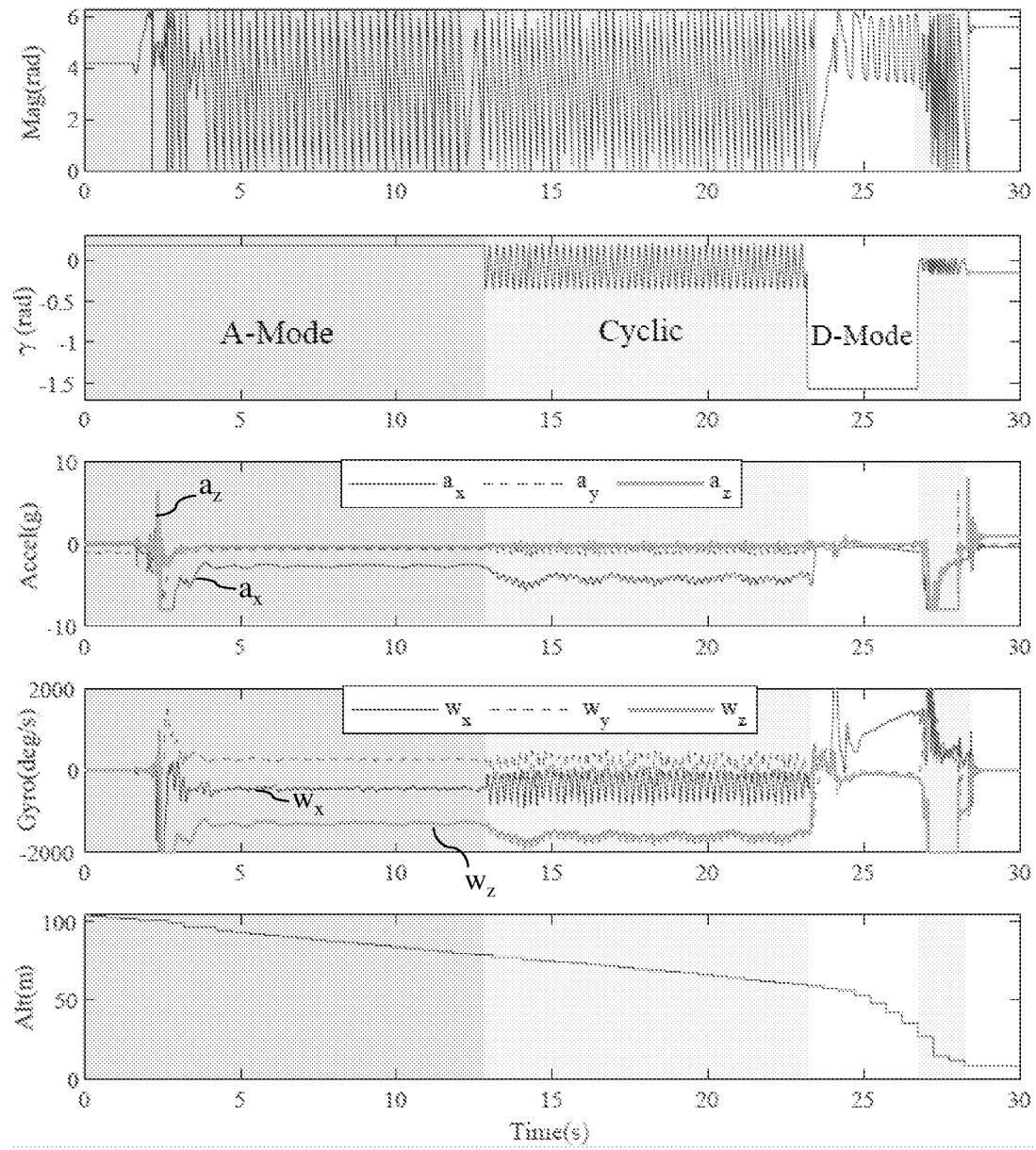


FIG. 23

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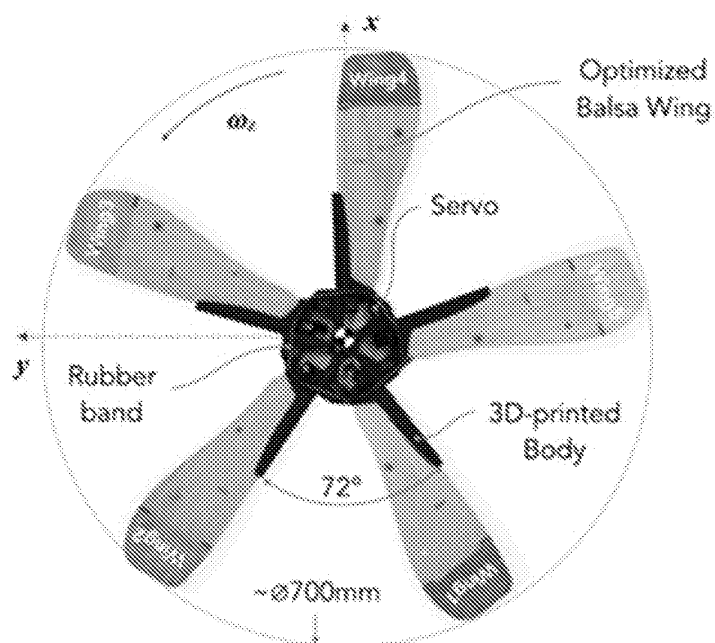


FIG. 24A

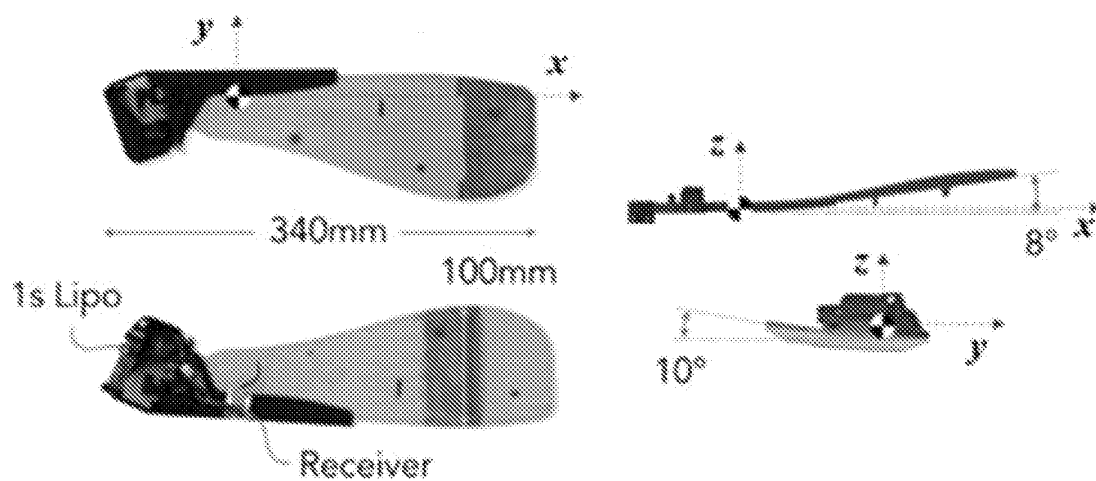


FIG. 24B

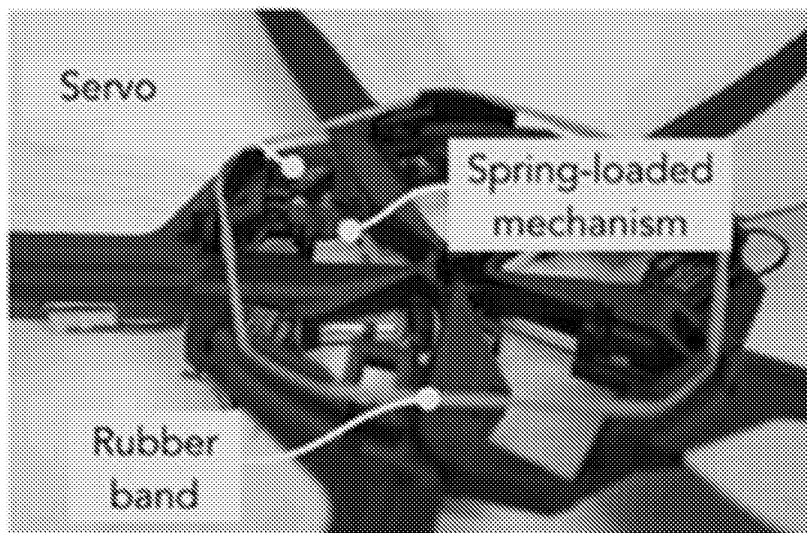
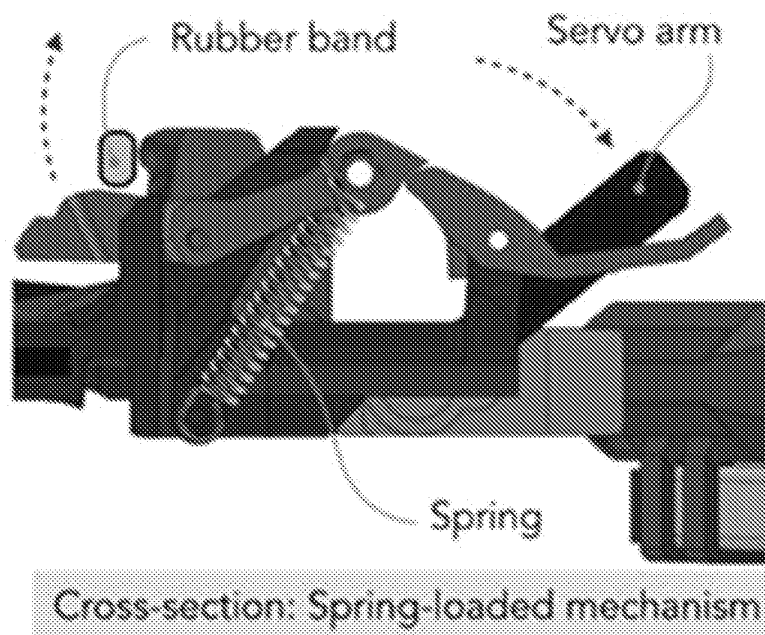


FIG. 24C

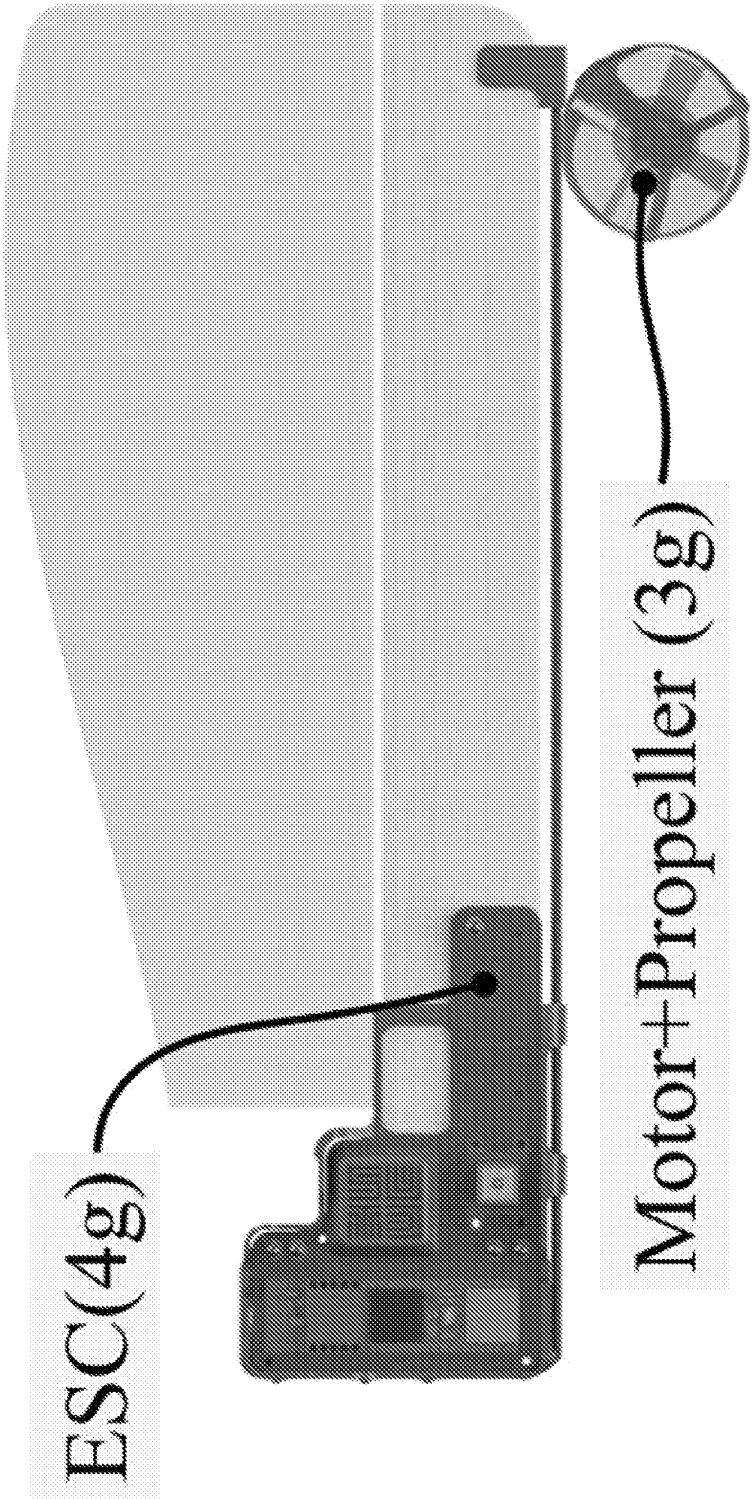


FIG. 25

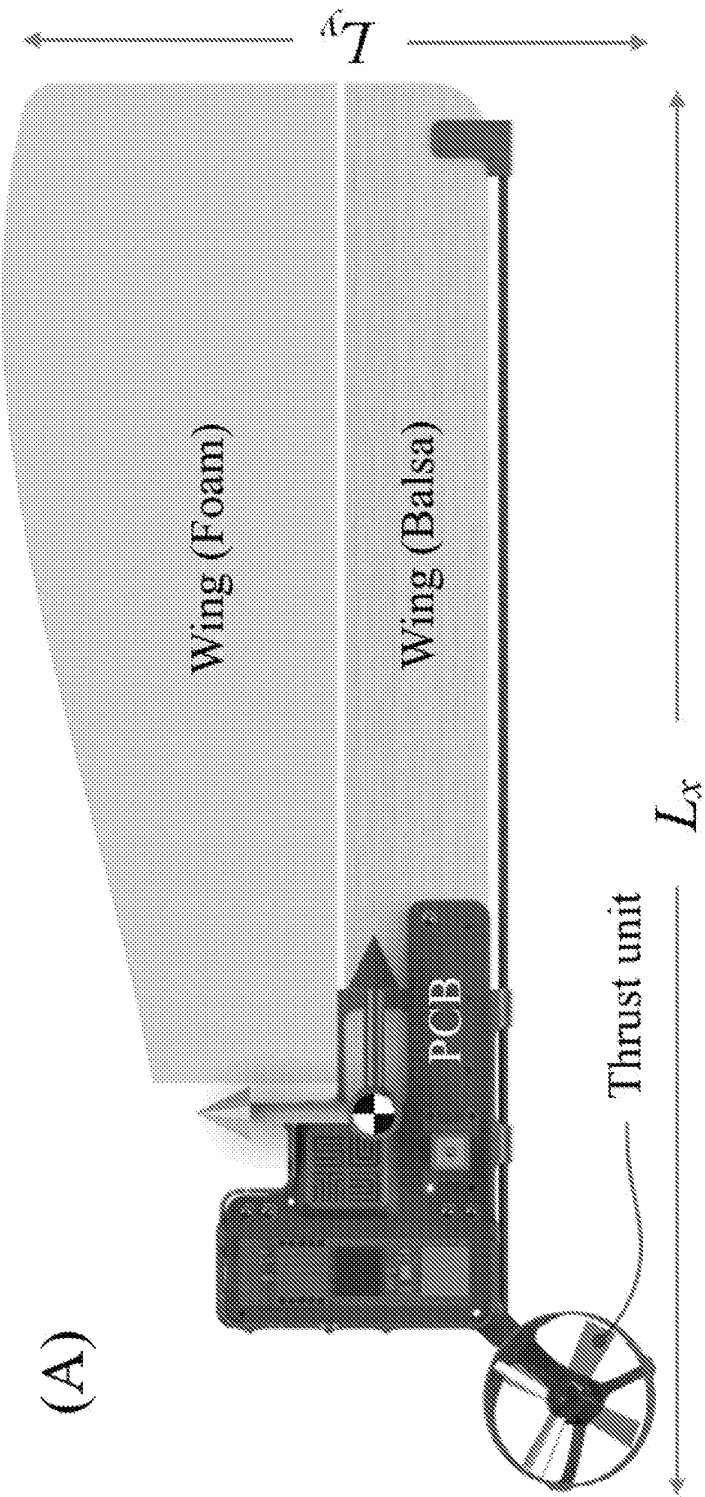


FIG. 26A

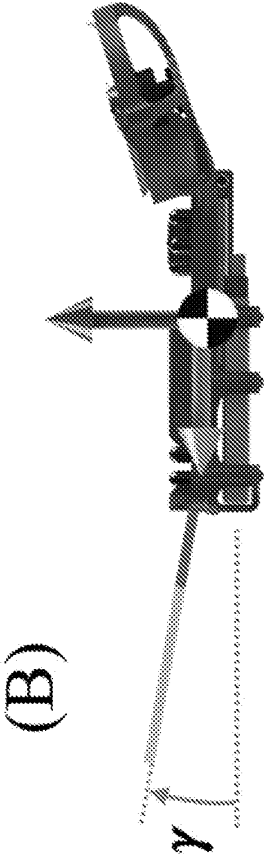


FIG. 26B

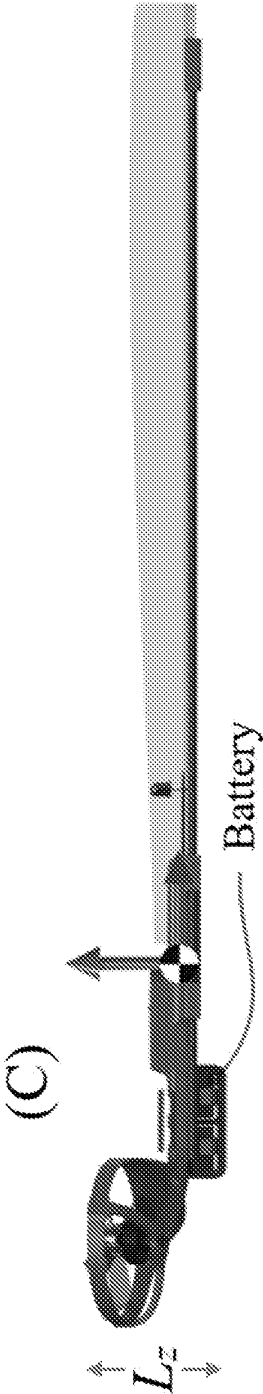


FIG. 26C

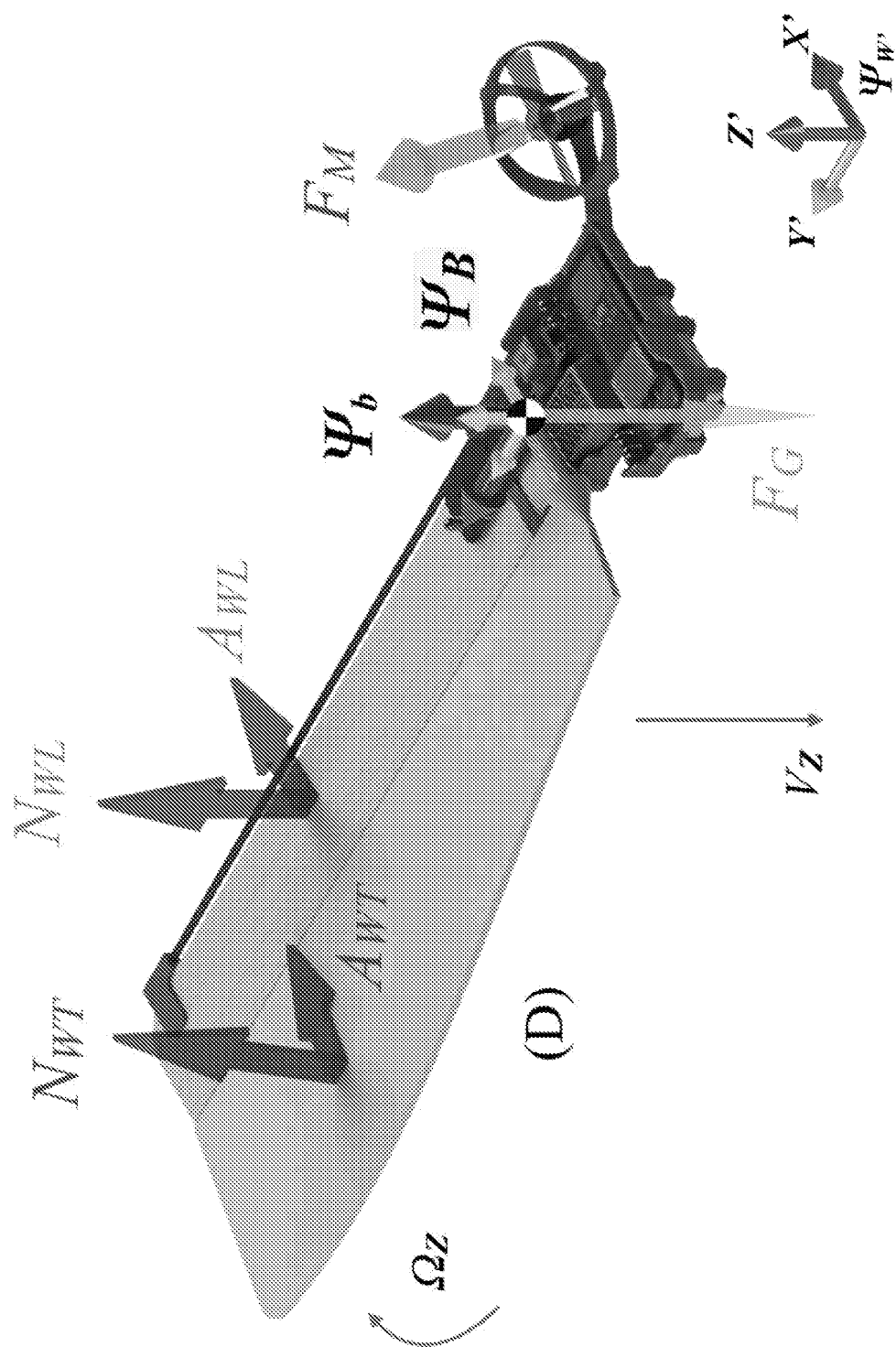


FIG. 26D

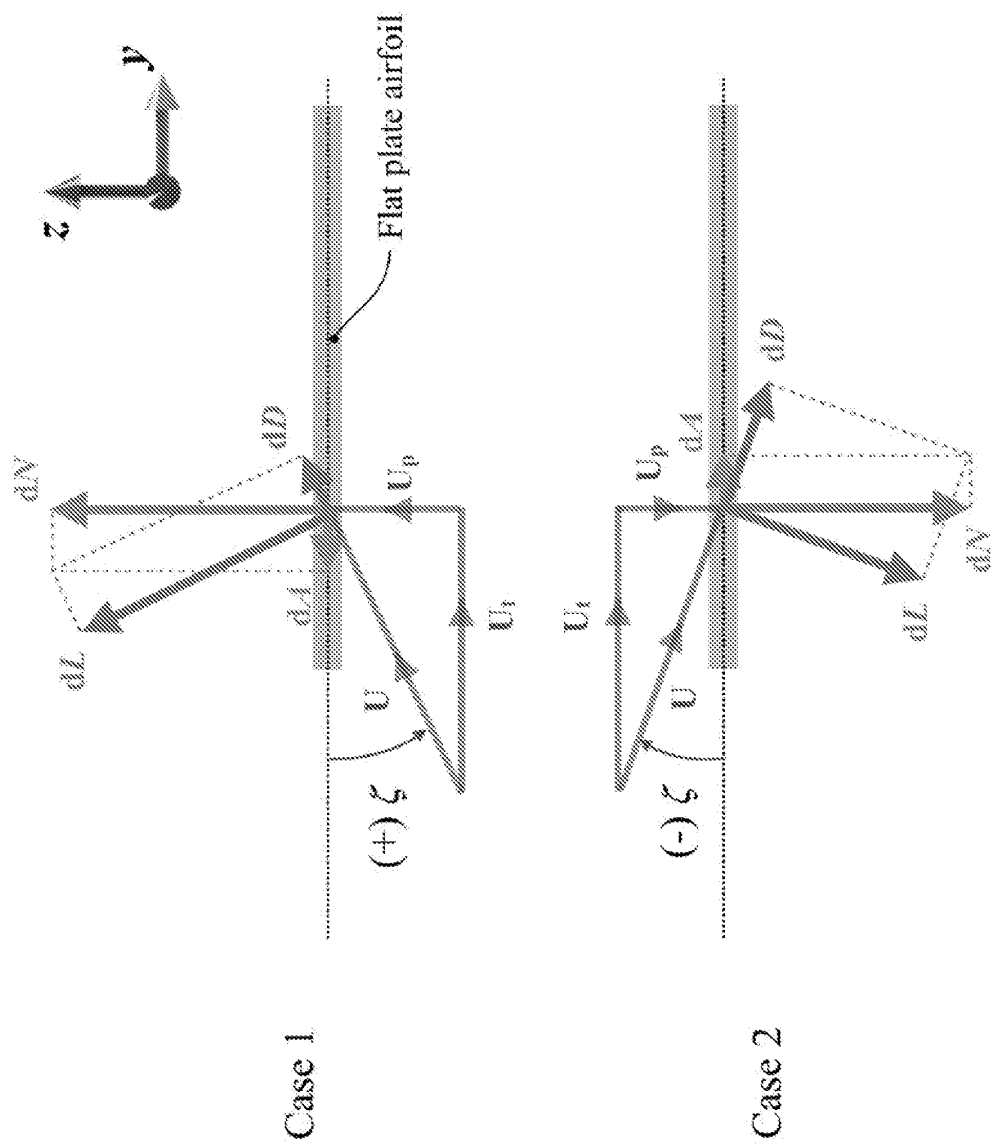


FIG. 27

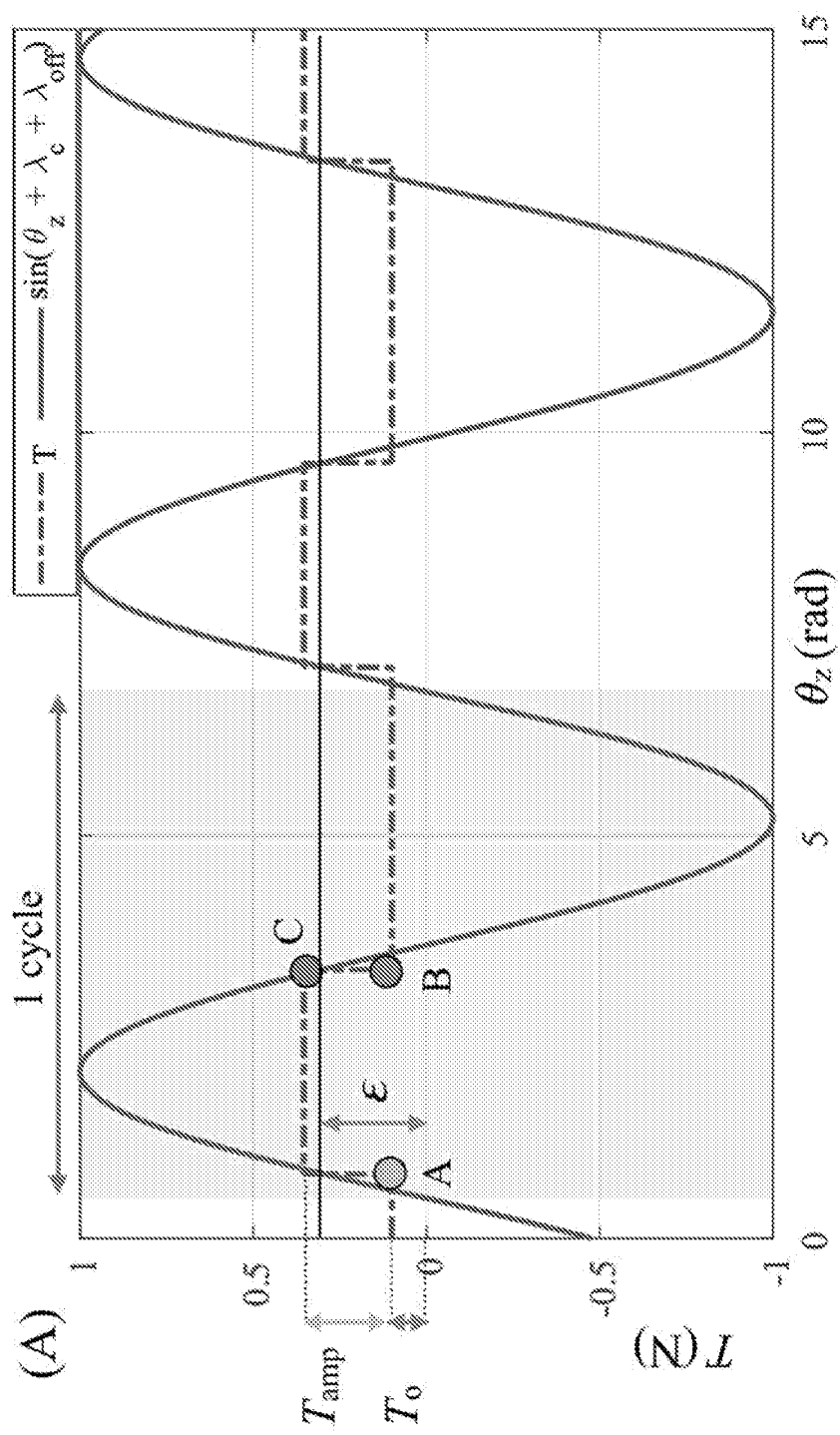


FIG. 28A

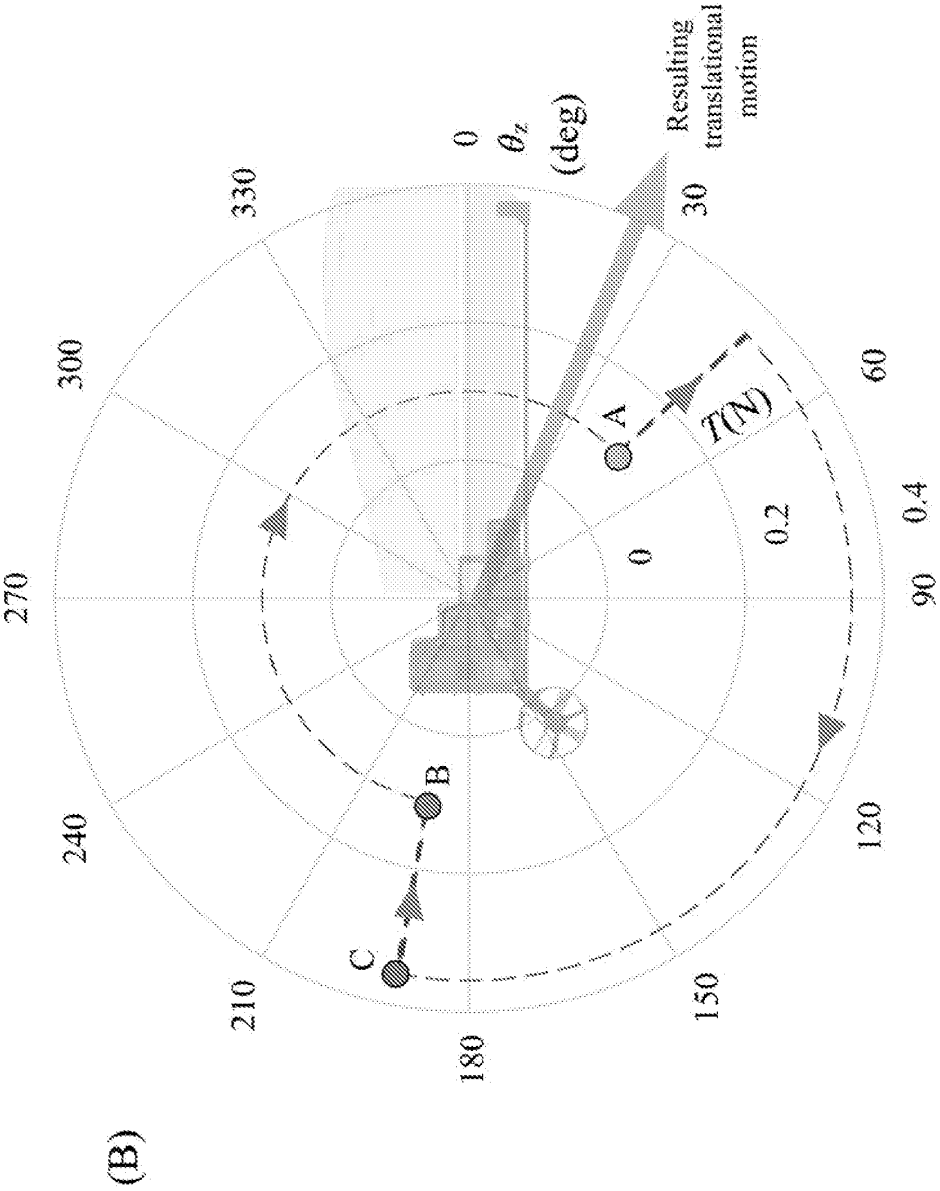


FIG. 28B

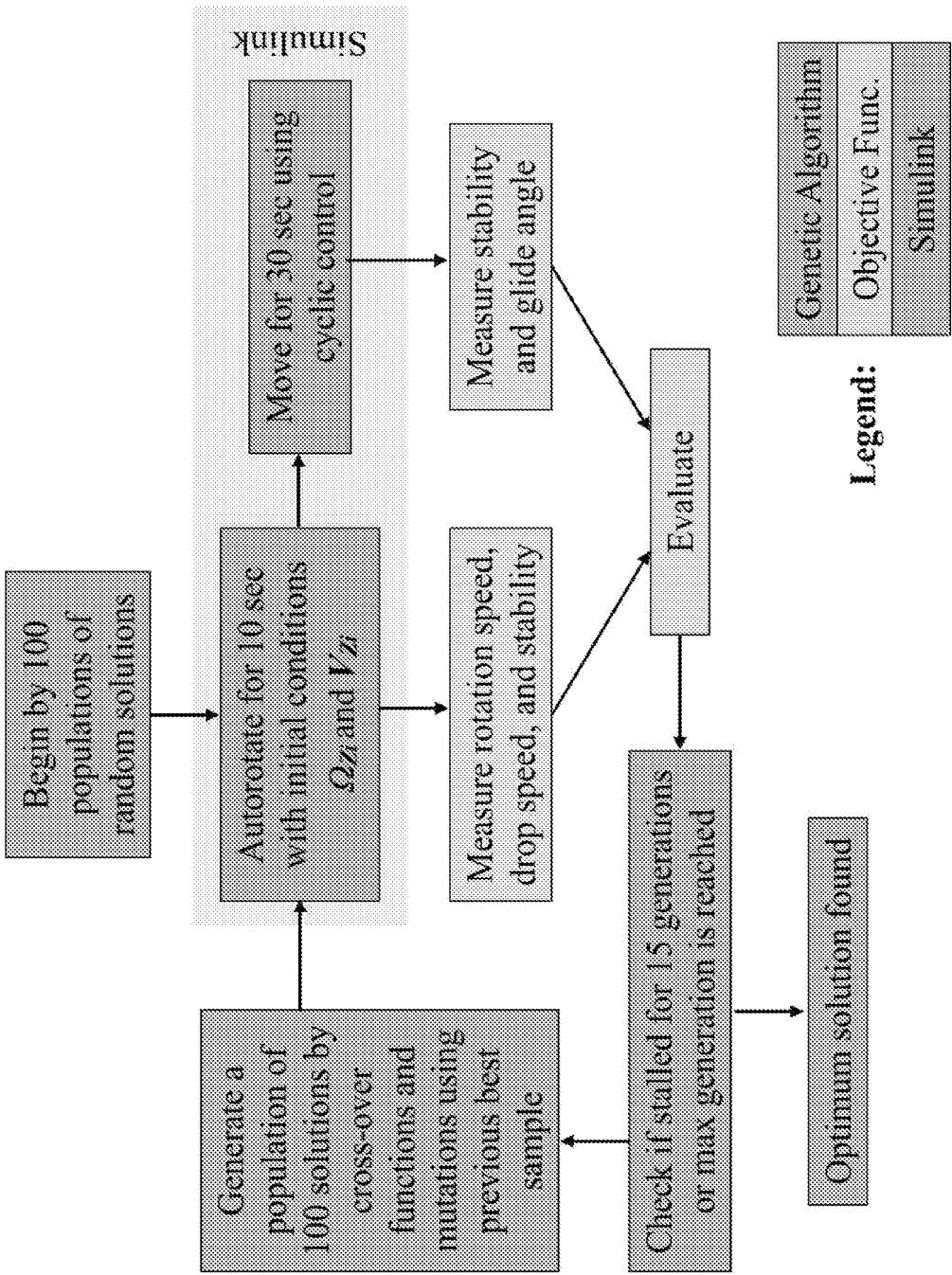


FIG. 29

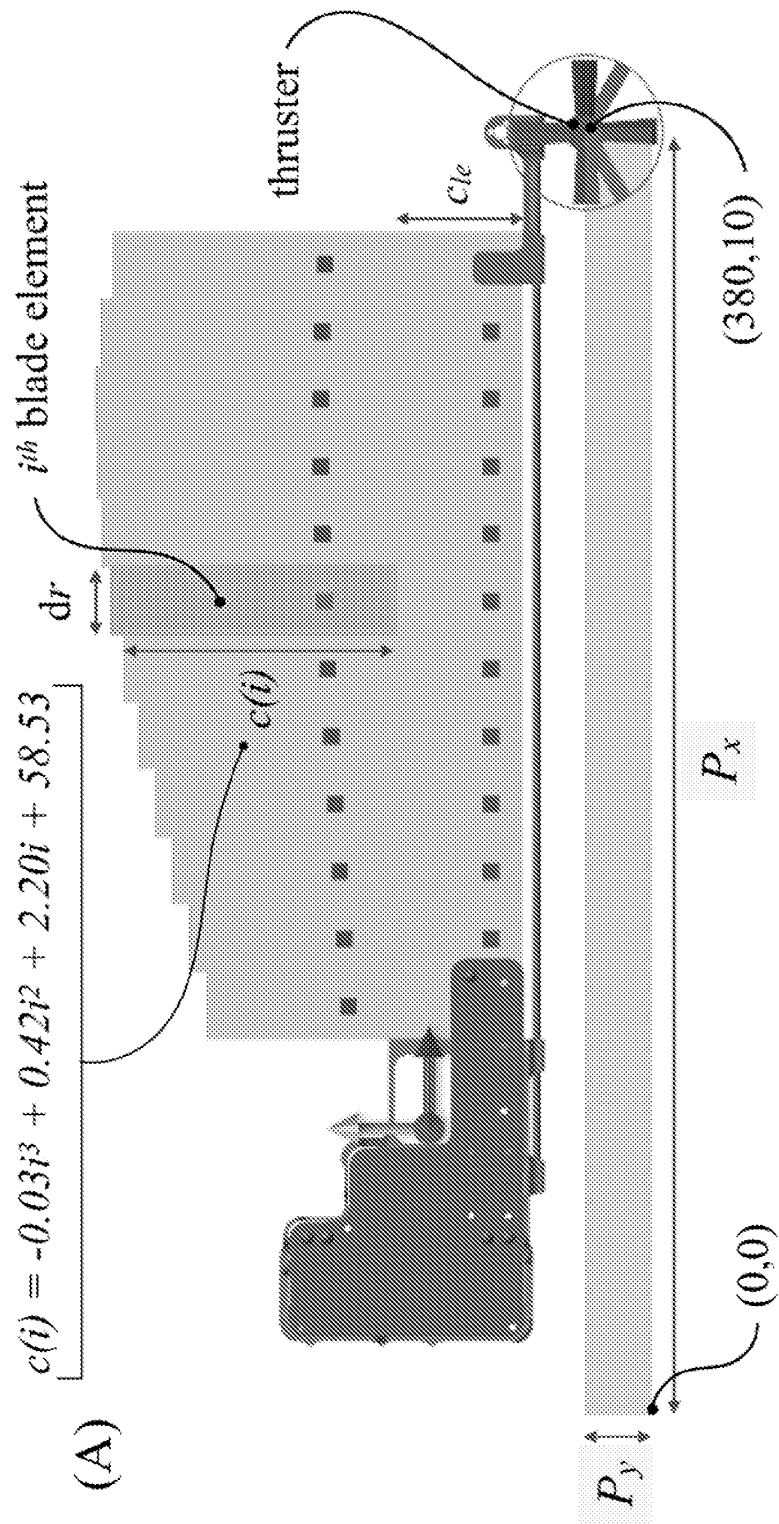


FIG. 30A

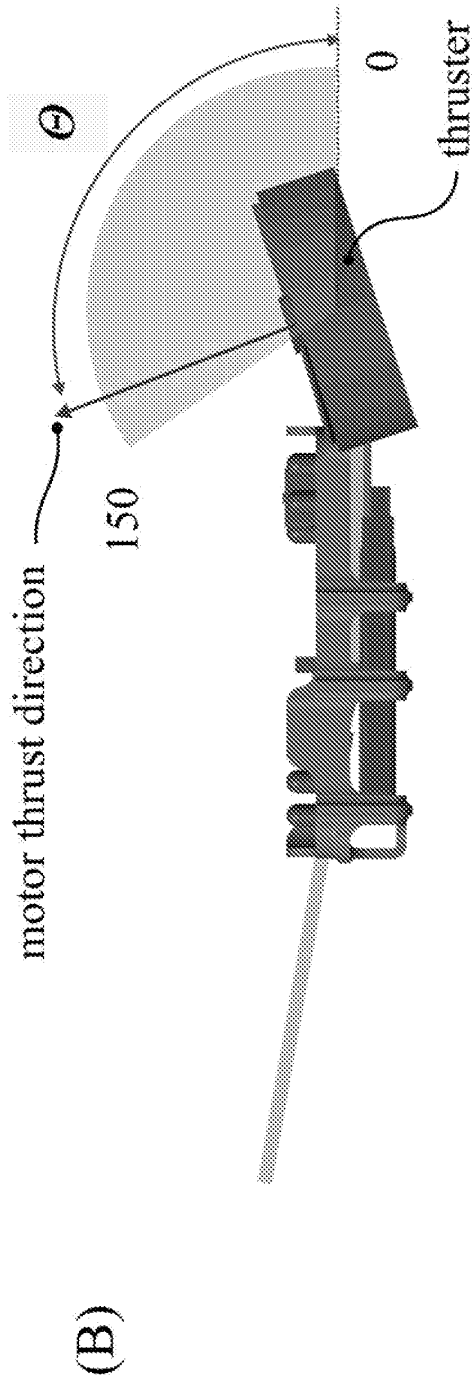


FIG. 30B

Table 6 TABLE OF SIMULATION PARAMETERS

PARAMETERS	
Environment	$\rho_{air} = 1.225\text{kg/m}^3, g = -9.81\text{m/s}$
Initial conditions	$V_Z = 0\text{m/s}, \Omega_Z = -18.85\text{rad/s}$
Objective fn coeffs	$\kappa_1 = 50, \kappa_2 = 20, \kappa_3 = 20,$ $\kappa_4 = 350, \kappa_5 = 800$
Others	$n_1 = 3000, n_2 = 9999, n_3 = 2000,$ $n_4 = 10000, n_5 = 40000$ $t_s = 10\text{s}, t_f = 40\text{s}$ $n_{be} = 12$
OPTIMIZED DESIGN VARIABLES	
Parameters	$P_x = 25\text{mm}, P_y = 5\text{mm}, \Theta = 106^\circ,$ $T_o = 0.0761\text{N}, T_{amp} = 0.3104\text{N},$ $\epsilon = -0.0087$
Others	$\gamma = 0.174\text{rad}, m = 68\text{g}$ $L_x = 350\text{mm}, L_y = 177\text{mm}, L_z = 39\text{mm}$

FIG. 31

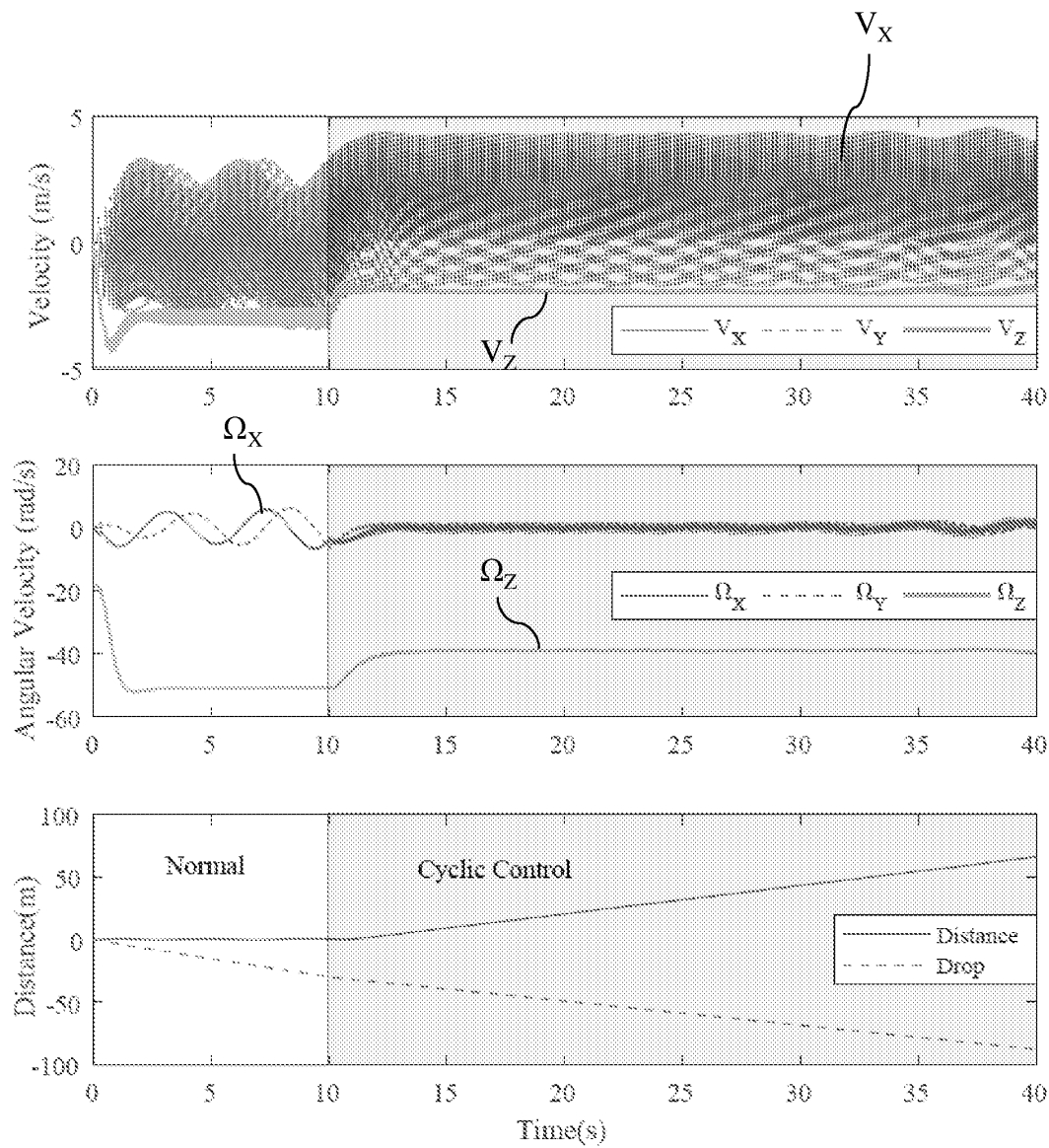


FIG. 32

Control Strategy	Thruster Config			
	Optimized		Arbitrary	
Square Cyclic	O1	[25, 5, 106] $GS = 40.91^\circ$ $t_s = 16.83s$	A1	[10, 360, 0] $GS = 41.15^\circ$ $t_s = 29.75s$
Sine Cyclic	O2	[25, 5, 106] $GS = 58.90^\circ$ $t_s = 26.88s$	A2	[10, 360, 0] $GS = 60.33^\circ$ $t_s = 39.98s$

FIG. 33

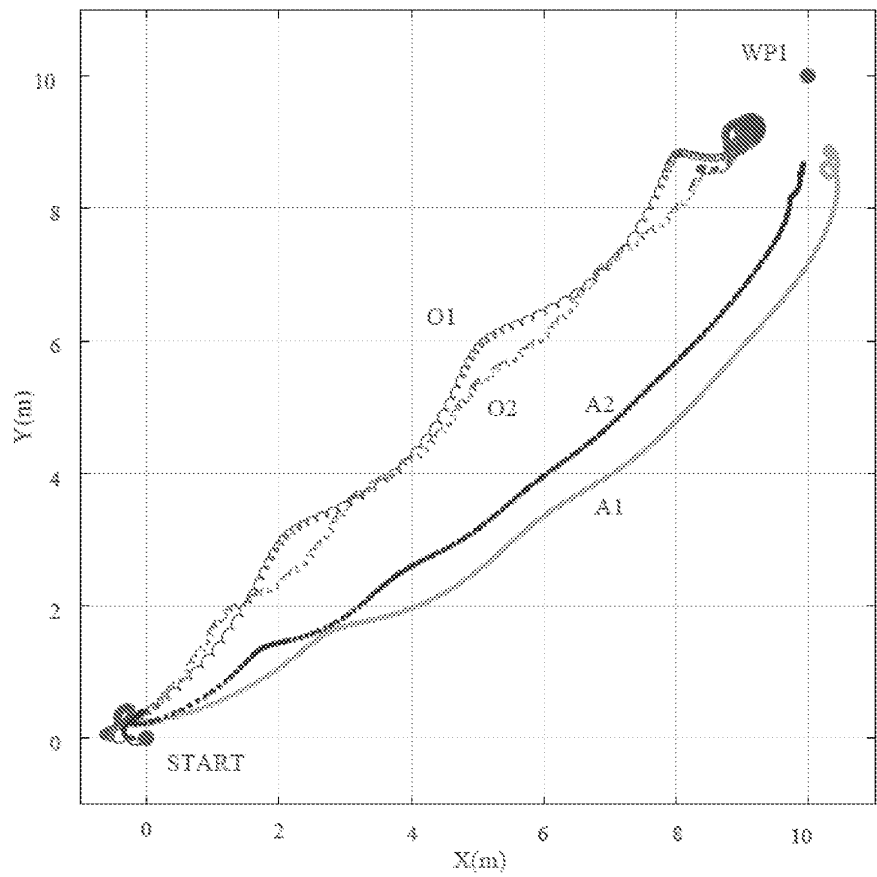


FIG. 34A

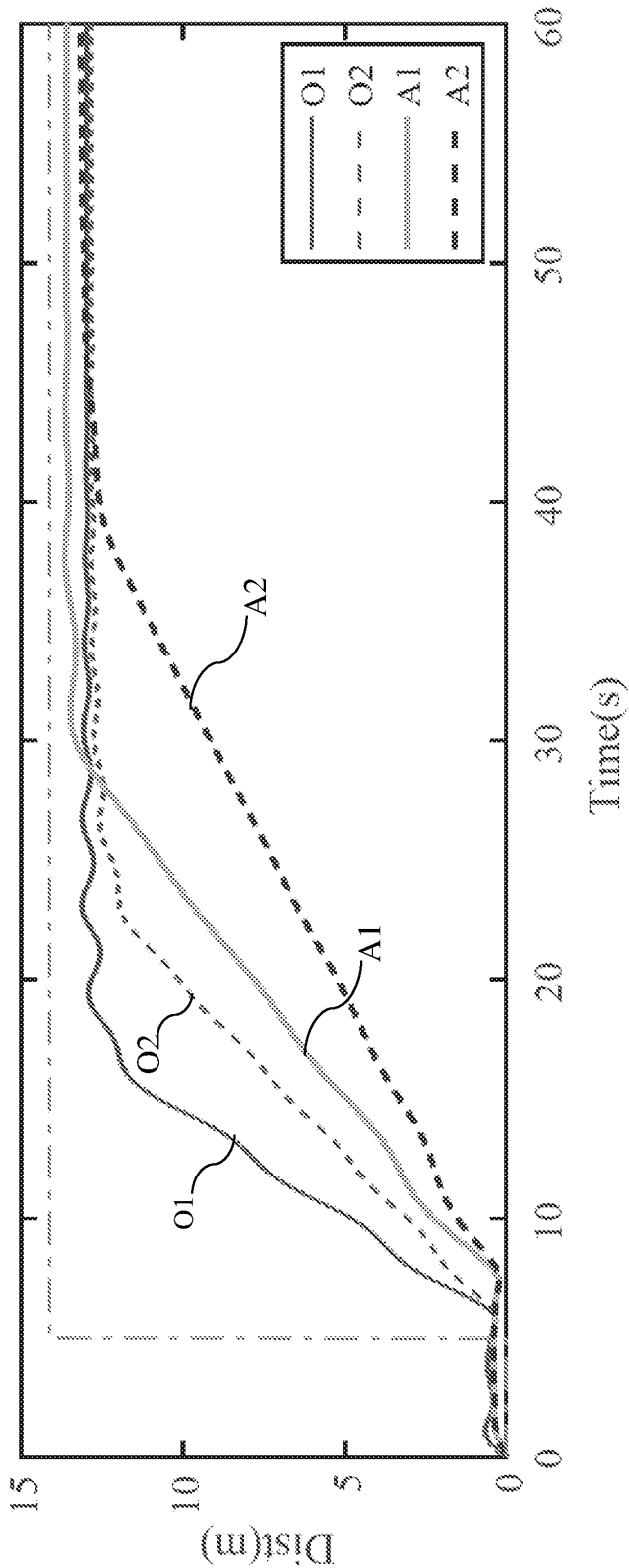


FIG. 34B

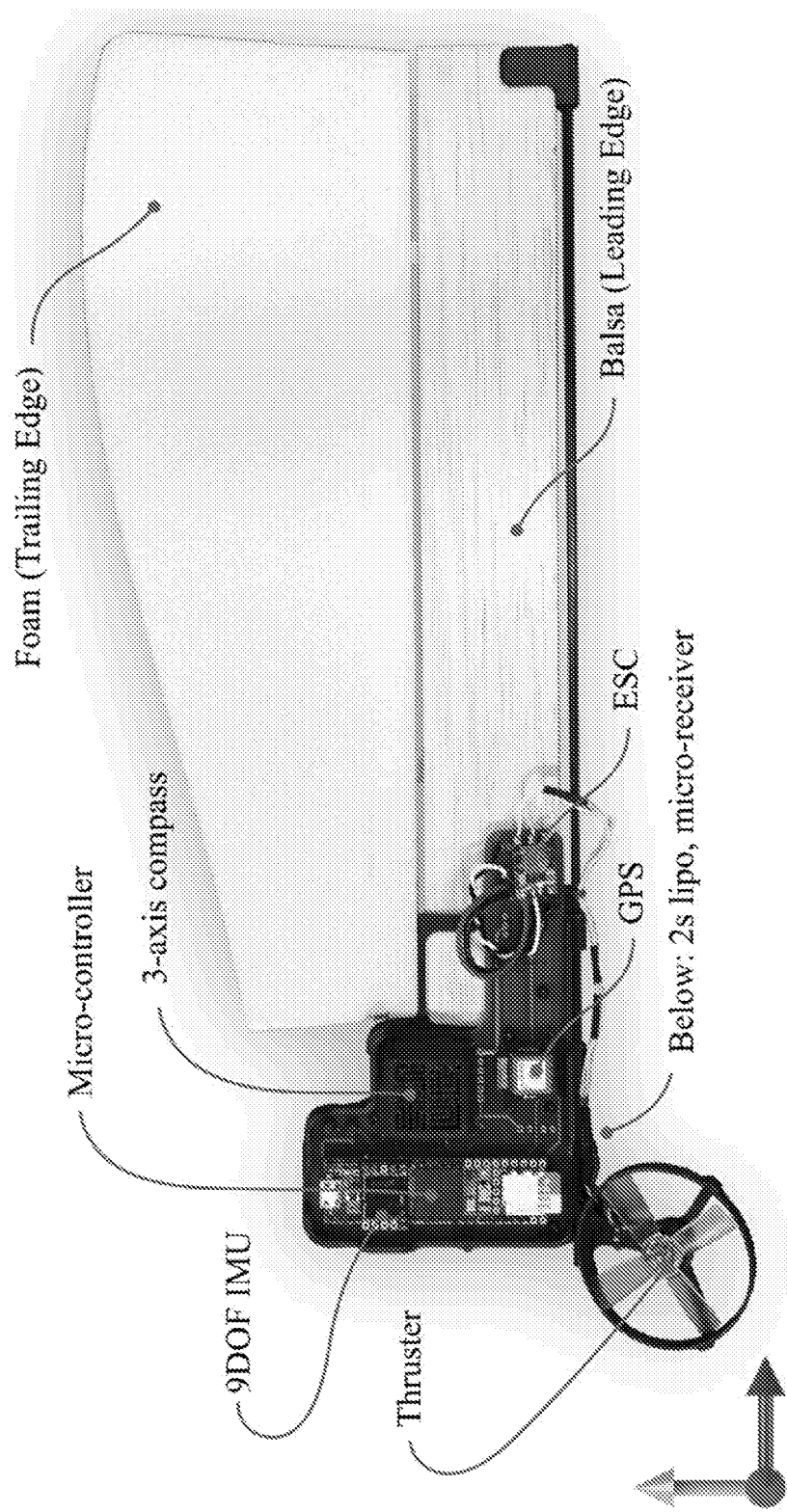


FIG. 35

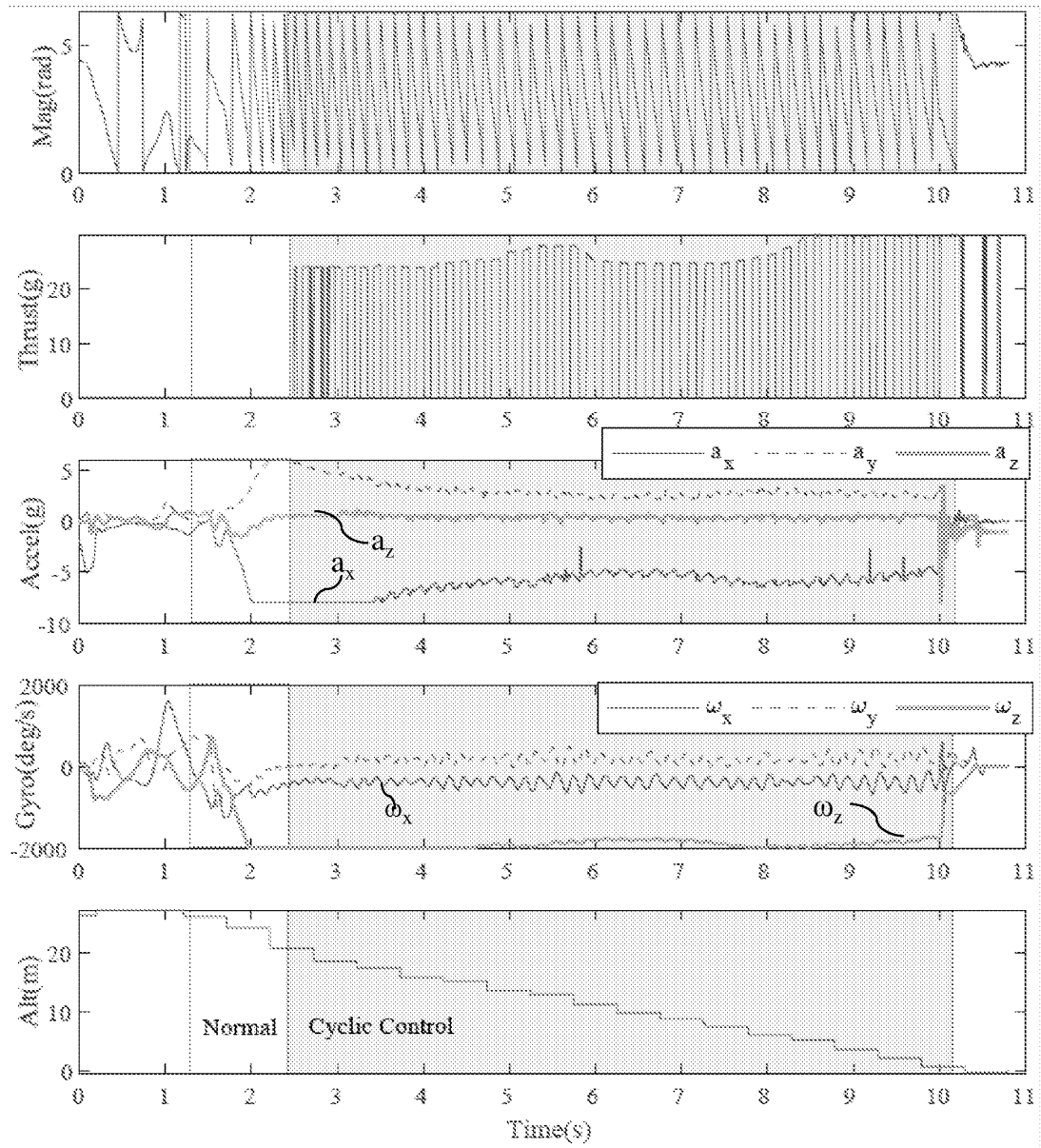


FIG. 36



FIG. 37