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Comparison of Size and Performance of Small Vertical and Short Takeoff and Landing UAS

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Abstract—**This paper presents a data-set of performance characteristics of nearly two hundred vertical/short takeoff and landing (V/STOL) uncrewed aerial systems (UAS). Characteristics of the UAS that are recorded include maximum gross takeoff weight, endurance, maximum length dimension, speed, payload, and payload fraction. The data-set is restricted to small UAS that weigh under 500 lbs. The results are visualized via scatter plots and statistically characterized. The performance of different UAS design types and UAS Group Numbers are compared. The data-set provides a snapshot of current capabilities of small UAS in the V/STOL category and may be useful to UAS developers and procurement agencies.**

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1. INTRODUCTION

Small uncrewed aerial systems (UAS) with vertical/short takeoff and landing (V/STOL) capabilities are used in applications such as infrastructure inspection, traffic monitoring, public safety, agriculture, aerial videography, medical/package delivery, and in military tasks. Compared to traditional runway-based platforms, V/STOL UAS are more mobile and versatile—they can be deployed with limited infrastructure, in rugged terrain, and in constrained environments (e.g., urban settings, ship decks). Various UAS designs have been developed that enable V/STOL capabilities, including helicopter, quadplane, tiltrotor, tailsitter, multirotor, and fixed-wing designs that are hand or catapult launched. Many V/STOL platforms support hovering and low-speed flight for missions that require holding a fixed or slow-moving position, landing/takeoff in constrained environments, or maneuvering at low speed around obstacles.

This study aggregates performance data for V/STOL platforms that weight 500 lbs or less—ranging from miniature first-person-view multirotor for acrobatic flying to larger heavy-lift helicopters. Many commercial platforms exist in this category making it challenging for end-users to decide which designs are most appropriate for their application, or for UAS designers to comprehensively compare new designs to existing systems. The data-set presented here contains nearly two hundred platforms and is analyzed to highlight unique characteristics and trends among different platforms.

Prior Work

Existing literature that reports UAS characteristics includes public vehicle data-sets and academic works. For example, AUVSI's Uncrewed Systems & Robotics Database (USRD) [1] and Janes All The World's Aircraft: Unmanned 22/23 Yearbook [2] provide platform specifications for a broad range of UAS. Open-access data-sets include the Unmanned Systems Technology database [3] and the Center for a New American Security database [4]. Past survey articles of UAS systems include [5], [6]. Work in [7–10] encompasses larger aircraft and discusses empirical correlations between aircraft parameters, such as size, weight, wing and tail geometries, and propulsion. Reference [9] focuses on rotorcraft and suggests empirical scaling laws and characterizes variation in battery characteristics among platforms. The authors in [11, 12] perform similar studies on small fixed-wing, rotary-wing, and hybrid UAS that include analysis of datalink range, altitude, endurance, size and weight. Work in [13] discusses propulsion sizing for electric and fuel-powered UAS. Reference [14] provides an overview of the UAS market and compares UAS speed, payload, range, endurance, and propulsion type. In contrast to prior work, this paper focuses specifically on small V/STOL platforms (under 500 lbs) with an emphasis on identifying performance trends among different platform design types.

Contributions

The contributions of this paper are: (1) a data-set of the performance and properties of small vertical/short takeoff and landing uncrewed aerial systems, and (2) a visualization of these data along with their statistical characterization. The resulting data is interpreted and discussed in the context of the merits and drawbacks of various V/STOL designs. The overall performance gaps across the range of current V/STOL platforms are also identified. The data-set and analysis of this paper may be useful to UAS developers for preliminary

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sizing, conceptual design, and performance comparison. It may also benfit procurement agencies to provide a snapshot of the design space occupied by current small-sized UAS in the V/STOL category.

Paper Organization

The remainder of the paper is organized as follows. Section 2 describes the methodology of the data collection process and summarizes the data-set. Section 3 visualizes the data and discusses observed trends and outliers. Section 4 concludes the paper and suggests future work.

2. DATA COLLECTION METHODOLOGY

This section describes the methodology used to identify small V/STOL UAS platforms parameters and summarizes the data-set obtained.

Data Collection

A list of UAS vendors and platform names was first generated from online open-access resources, such as the Blue UAS Cleared List [15], Unmanned Systems Technology database [3], Center for a New American Security database [4], and other published sources [5]. Platforms were investigated further if they met the following criteria: (a) have V/STOL capabilities, (b) were actively in use, and (c) were within the weight class for the study.

Data was collected for UAS with a maximum takeoff weight (MTOW) under 500 lbs. This weight range corresponds to Group 1, Group 2, and a subset of Group 3 UAS classifications as specified by the U.S. Department of Defense (as outlined in Table 1 below). According to other classifications this weight range refers to *small UAS* $<$ 25 kg ($<$ 55 lbs) or a subset of *medium UAS* 25–2,000 kg (55–4,409 lbs) as delineated by the International Telecommunication Union [16]. NATO UAS categorization classifies this weight range as Class I $<$150 kg ($<$330 lbs) or a subset of Class II 150–600 kg (330–1323 lbs) with subgroupings of *mini* $<$ 15 kg, *small* $<$ 150 kg, or *tactical* 150–600 kg.

Table 1. U.S. Department of Defense UAS classification [17]. This article analyzes Group 1, Group 2, and a subset of Group 3 UAS. Altitude values are given in feet above ground level (AGL) or according to flight level (FL).

UAS Group	Maximum takeoff weight (lbs) (MTOW)	Nominal operating altitude (ft)	Speed (knots) [mph]
Group 1	0–20	$<$ 1,200 AGL	100 [115]
Group 2	21–55	$<$ 3,500 AGL	$<$ 250 [289]
Group 3	$<$ 1,320	$<$ FL 18,000	$<$ 250 [289]
Group 4	$>$ 1,320	$<$ FL 18,000	Any airspeed
Group 5	$>$ 1,320	$>$ FL 18,000	Any airspeed

Each platform was investigated further by obtaining the corresponding data-sheet or web-page listing its specifications. Other available models from the same vendor were reviewed and included if they met the required criteria. The vendor-stated speed (miles per hour), maximum takeoff weight (lbs), payload capacity (lbs), and flight time (minutes) were converted to common units and recorded. UAS size (feet) was recorded as the longest dimension of the vehicle as measured by the platform provider. In the absence of data a particular field was left empty or inferred from other available information (e.g., payload was computed as the difference between the MTOW and empty weight). The payload fraction was computed as the ratio of payload weight to MTOW. The platform type was categorized as either a fixed-wing aircraft, helicopter, multirotor, quadplane/tiltrotor, tailsitter, or first-person-view (FPV) multirotor drone. Fixed-wing platforms were included and considered to have V/STOL capabilities if they were designed for catapult or hand launch. Loitering munitions and other weaponized UAS were included if all other criteria were met. A UAS Group Number was assigned to each platform by considering the MTOW only (i.e., regardless of speed). The country of origin for each platform was determined based on the address for the headquarters of each vendor. Each entry in the resulting data-set has a known MTOW, length, and speed (entries missing all three parameters were discarded).

Summary of Data-set

In total, the specifications of 189 platforms are included in the presented data-set[1]. The distribution of the data across platform types, UAS Group Number, and country of origin is provided in Table 2. The data included platforms from 31 countries. Of these, the five largest countries of origin in the data-set make up 63% of the data. The data represents platforms from 108 unique UAS manufacturers.

Table 2. Distribution of data collected among platform types, UAS group types, and countries of origin

Platform Type	No. Entries	Percentage
Fixed-wing	61	33.3 %
Helicopter	26	14.2 %
Multirotor	40	21.9 %
Quadplane / Tiltrotor	37	20.2 %
Tailsitter	11	6.0 %
FPV Multirotor Drone	4	2.2 %
Group 1	79	43.2 %
Group 2	59	32.2 %
Group 3	45	24.6 %
United States	68	36.0 %
China	18	9.5 %
Israel	16	8.5 %
Spain	9	4.8 %
Canada	8	4.2 %
Slovenia	7	3.7 %
United Kingdom	7	3.7 %
Russia	6	3.2 %
Portugal	5	2.7 %
Ukraine	5	2.7 %
Netherlands	4	2.1 %
Italy	4	2.1 %
France	3	1.6 %
Germany	3	1.6 %
Turkey	3	1.6 %
Other	19	10.1 %

3. RESULTS AND DISCUSSION

This section presents the data collected in the context of four main platform characteristics: maximum speed, size, payload, and maximum flight time. These characteristics were visualized using the following two techniques:

[1]The data-set is available online: `https://github.com/robotics-uncc/VSTOL_UAS_Database`

1. Scatter plots that depict the density of the measured points and illustrate how the characteristics scale with MTOW.
2. Violin plots [18] that cluster UAS either by their design type or UAS Group Number (for UAS Groups 1–3) and depict within-cluster variation. Violin plots (see middle and lower panels in Figs. 1–4) use a shaded area to represent a rotated kernel density estimate of the data. The white circle represents the mean, and the grey bars are inter quartile ranges, similar to a traditional box-and-whisker plot. Data points are jittered along the horizontal axis for clarity.

Size Comparison

The data-set comparing platform size is presented in Fig. 1. The top panel depicts the relationship between UAS maximum takeoff weight and UAS size. As expected, heavier platforms correspond to larger platform dimensions. The relationship between size and weight is positively correlated in the range of 0–100 lbs. Larger platforms weighing over 100 lbs do not exhibit the same correlation. The heaviest platform in the data-set is a large helicopter (Schiebel: Camcopter S-100) which has a weight of 441 lbs and a rotor diameter of 11.2 ft as its maximum dimension. While this vehicle is the heaviest in the data-set, it is nearly half the length of largest platform (by size)—a fixed-wing aircraft with a wingspan of 21 ft and weight of 165 lbs (Aeronautics System: Orbiter 5). Among the different UAS types (middle panel) the FPV multirotors were both the lightest and smallest platforms, whereas quadplanes/tiltrotors and helicopters had the largest mean size.

As expected, size is correlated with increasing UAS Group Number (lower panel). The mean UAS size was approximately 4.6 ft, 7.5 ft and 10.4 ft, for Groups 1, 2, and 3, respectively.

Speed Comparison

Figure 2 (top panel) compares UAS maximum takeoff weight and maximum attainable speed. Most of the platforms studied (89%) have a maximum speed of 140 mph and are less than 140 lbs. Multicopters are among the slowest platforms with the exception of FPV multirotor type models (see middle panel). The distribution of the speed data appears clustered around the mean for most UAS types with the exception of a few outliers. The Group 1 outlier is a highly optimized FPV Multirotor Drone (RacerX) that can reach a speed of 179 mph and weighs only 1.80 lbs. The Group 3 outliers include a turbojet powered quadplane (Woot Tech: Firebolt) and a turbojet powered quadrotor (Wave Aerospace: Sea Huntress II). Other quadplanes use conventional propeller-driven systems. The result highlight the difficulty of designing high-speed UAS (> 140 mph) that are relatively small and lightweight.

A significant proportion of the Group 1 and Group 2 UAS (last panel) have speed either above or below the 115 mph cutoff for Groups 1 and 2 (see Table 1). Similarly, Group 3 UAS have maximum speeds as low as 40 mph (typical for Group 1) but all Group 3 platforms have speeds below the 287 mph speed boundary between Groups 3 and 4. These results illustrate that many UAS cannot be unambiguously classified into a specific UAS Group Number when both weight and speed are considered.

Flight Time Comparison

Figure 3 (top panel) depicts the correlation between UAS MTOW and the UAS flight time. About 75% of the platforms have a flight endurance of four hours or less and 36% have a flight endurance of 1 hour or less. The data in the fourth

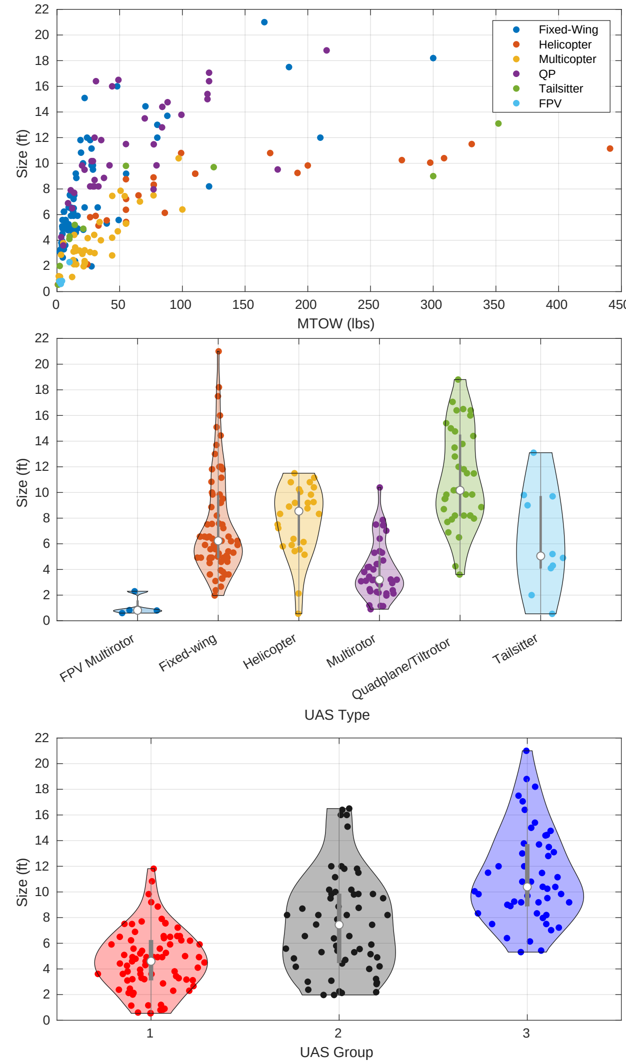

Figure 1. Comparison of UAS size with maximum takeoff weight (MTOW), UAS type, and UAS Group Number.

panel has a distinctive bottom-heavy skew; many platforms achieve low flight endurance times (e.g., less than 3 hours) and greater endurance values are less common. Fixed-wing, tailsitter, and quadplane/tiltrotor platform types achieve substantially higher flight times than multirotors, FPV drones, or helicopters. Group 1 UAS are generally limited to 5 hours or less of flight time. Group 2 UAS have an intermediate endurance of 12 hours or less and Group 3 UAS have endurances surpassing 24 hours. The outliers in the UAS Group 2 category include a gas-powered quadplane (Tekever: AR3) with an endurance of 18 hours and a gas-powered tailsitter (Volatus Flexrotor) with an endurance of 24 hours. Electric platforms often have lower endurance than their gas-powered counterparts.

Payload Comparison

Typical payloads onboard V/STOL UAS include imaging sensors (visual/infrared spectrum), hyperspectral cameras, thermal sensors, LiDAR, GPS, acoustic transducers, gas analyzers, and synthetic aperture radar. Helicopters have the largest mean payload capacity and, like tailsitters, can carry payloads up to approximately 110 lbs (see Fig. 4). Fixed wing

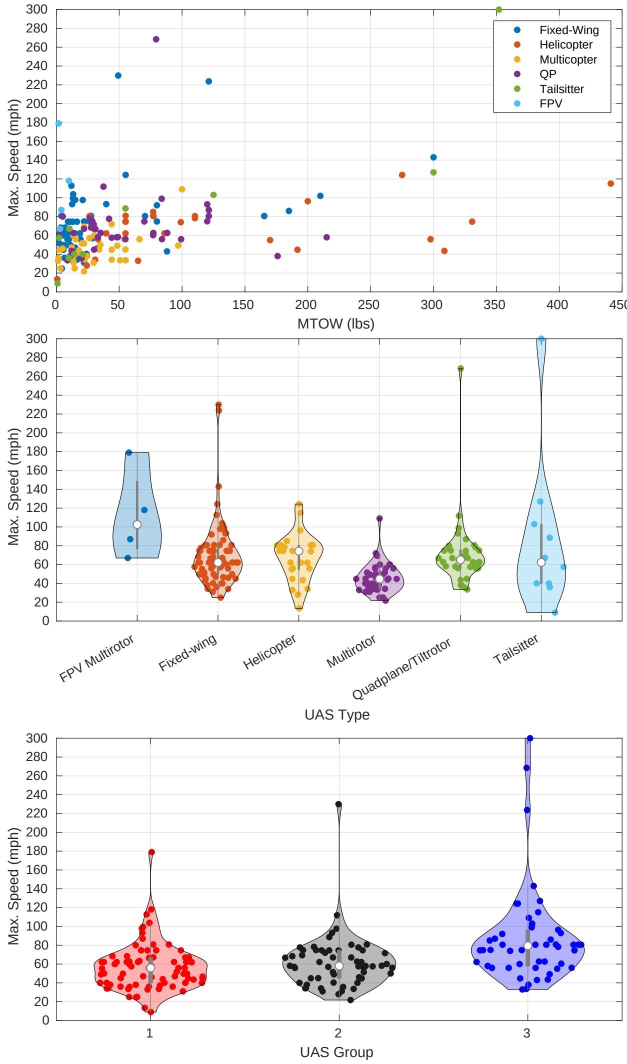

Figure 2. Comparison of UAS maximum speed (miles/hour) with maximum takeoff weight (MTOW), UAS type, and UAS Group Number.

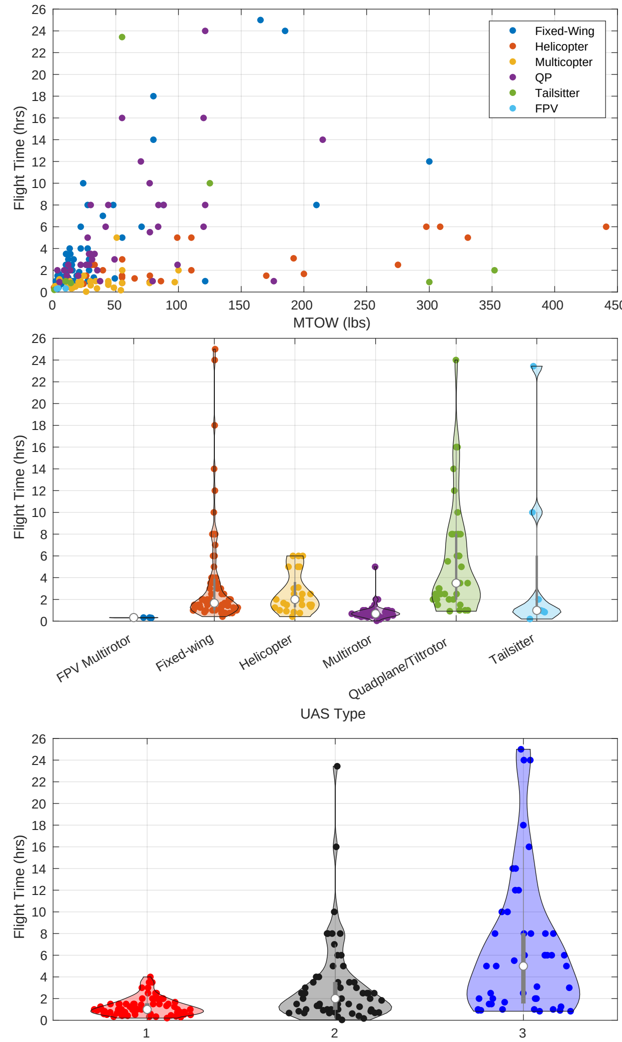

Figure 3. Comparison of UAS endurance with maximum takeoff weight (MTOW), UAS type, and UAS Group Number.

aircraft and FPV multirotor drones have the smallest payload capacity, whereas multirotors and quadplanes/tiltorotors have intermediate capacity. Group 3 UAS are on average twice as large as Group 1 UAS but can carry over three times as much payload. The payload fraction with maximum takeoff weight (MTOW) is plotted in Fig. 5. The data shows that some smaller platforms (MTOW <100 lbs) have large payload fractions of 0.5 or greater. Heavier platforms generally have smaller payload fractions that decrease with weight.

4. Conclusion

A data-set of the characteristics of 189 vertical short takeoff-landing (V/STOL) platforms that weigh less than 500 lbs was generated using open-source information. The platforms were characterized according to their size, maximum speed, flight endurance, and payload capabilities. The variation in these characteristics was then visualized against (a) maximum takeoff weight, (b) UAS platform types (fixed-wing, helicopter, multirotor, quadplane/tailsitter, FPV multirotor drone), and (c) UAS Group Number (either Group 1, 2, or 3). The analysis illustrates how the characteristics scale as platform size increases and the variation among different UAS designs. Outliers were identified and their design features were discussed. Future studies may consider enlarging the data-set and recording additional characteristics (e.g., ceiling altitude, battery characteristics, and communication/control range), and developing empirical relations among these parameters.

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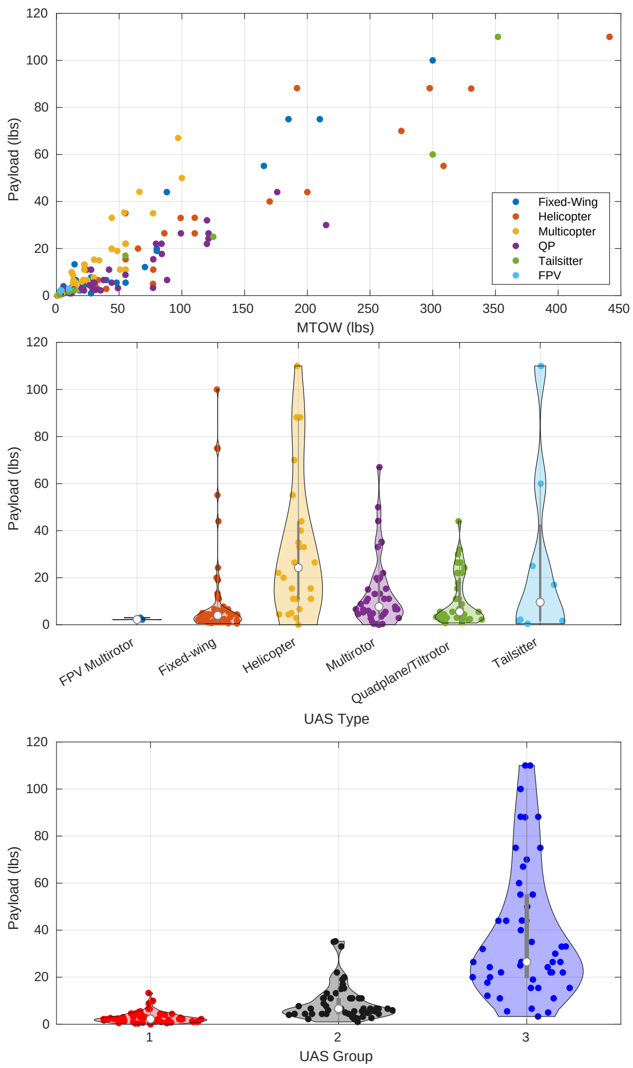

Figure 4. Comparison of UAS payload with maximum takeoff weight (MTOW), UAS type, and UAS Group Number.

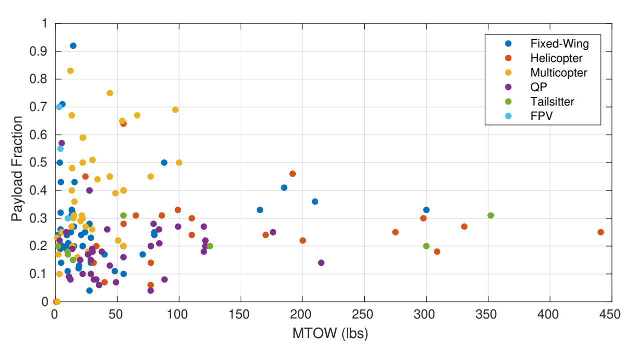

Figure 5. Comparison of UAS payload fraction with maximum takeoff weight (MTOW).

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APPENDICES

The data-set is listed in the following three tables. Some vendor and platform model names appear truncated due to space constraints (details can be inferred from the corresponding reference cited).

Table 3. Data collected for helicopter (HELI), first-person-view multirotor drone (FPV), and multirotor (MULTR) platforms.

No.	Type	Vendor	Model	Weight (lbs)	Size (ft)	Speed (mph)	Pay -load (lbs)	Pay -load frac.	Endur. (hours)	UAS Group	Country
1	HELI	VELOS	V3 [19]	55.0	6.4	74.6	35.0	0.64	1.33	2	USA
2	HELI	Aerovironment	VAPOR [20]	65.0	7.5	33.0	20.0	0.31	1.25	3	USA
3	HELI	UAVOS	UVH 25EL [21]	55.0	8.8	62.1	11.0	0.20	1.50	2	USA
4	HELI	Steadicopter	Black Eagle 50H [22]	110.2	9.2	78.3	26.5	0.24	5.00	3	Israel
5	HELI	Anduril	Ghost [23, 24]	37.0	8.9	85.0	10.0	0.27	0.92	2	USA
6	HELI	UAVOS	UVH 170 [25]	99.0	10.8	74.0	33.0	0.33	5.00	3	USA
7	HELI	Aeroscout	Scout B1-100 [26]	170.0	10.8	55.0	40.0	0.24	1.50	3	Switzerland
8	HELI	UMS Skeldar	V-150 [27]	330.7	11.5	74.6	88.0	0.27	5.00	3	Switzerland
9	HELI	ZIYAN UAS	Falcon-10 [28]	55.1	5.4	80.8	15.4	0.28	0.83	3	China
10	HELI	ZIYAN UAS	Blowfish A2G [29]	86.0	6.1	62.1	26.5	0.31	1.00	3	China
11	HELI	ZIYAN UAS	Ranger P2X PTK [30]	39.7	5.5	62.1	2.9	0.07	2.00	2	China
12	HELI	Alpha Unmanned	Alpha 800 [31, 32]	30.9	5.9	34.2	4.4	0.14	2.50	2	Spain
13	HELI	Swiss Drones	SDO 50 V2 [33]	191.8	9.2	44.7	88.2	0.46	3.10	3	Switzerland
14	HELI	Schiebel	Camcopter S-100 [34]	441.0	11.2	115.1	110.0	0.25	6.00	3	Austria
15	HELI	Steadicopter	Black Eage 50E [22, 35]	110.2	9.2	80.5	33.1	0.30	2.00	3	Israel
16	HELI	Steadicopter	Black Eage 50 [22, 36]	77.2	8.3	80.5	11.0	0.14	–	3	Israel
17	HELI	FLIR	Black Hornet [37]	0.7	0.6	13.4	0.0	0.00	0.42	1	USA
18	HELI	4Front Robotics	Navig8 Electric [38]	24.2	2.1	28.0	11.0	0.45	0.75	2	Canada
19	HELI	4Front Robotics	Navig8-32 Gas [39, 40]	200.0	9.8	96.3	44.0	0.22	1.67	3	Canada
20	HELI	ZALA	421-02 [41]	297.6	10.1	55.9	88.2	0.30	6.00	3	Russia
21	HELI	ZALA	421-06 [41, 42]	26.5	5.8	80.5	4.4	0.17	1.50	2	Russia
22	HELI	Indela	I.N. Sky [43]	308.6	10.4	43.5	55.1	0.18	6.00	3	Belarus
23	HELI	Drone Hopper	Nuntius [44]	33.1	5.2	55.9	6.6	0.20	2.50	2	Spain
24	HELI	Drone Hopper	Titanium [44]	55.1	7.2	74.6	22.1	0.40	3.00	3	Spain
25	HELI	Steadicopter	Black Eagle 35E [22]	77.2	8.3	80.5	15.4	0.20	1.50	3	Israel
26	HELI	4Front Robotics	Navig8-56 Gas [40]	275.0	10.2	124.3	70.0	0.25	2.50	3	Canada
27	FPV	DJI	FPV [45]	4.0	0.8	87.0	2.2	0.55	0.33	1	China
28	FPV	DRL	RacerX [46]	1.8	0.8	179.0	–	–	–	1	USA
29	FPV	Lumenier	QAV-PRO [47]	10.0	2.3	118.0	3.0	0.30	0.33	1	USA
30	FPV	DJI	Avata [48]	3.1	0.6	67.0	2.2	0.70	0.30	1	China
31	MULTR	Parrot	ANAFI USA [49]	1.4	1.2	33.0	0.3	0.23	0.53	1	France
32	MULTR	Skydio	Skydio 2+ [50]	1.7	0.9	36.0	0.0	0.00	0.45	1	USA
33	MULTR	Skydio	Skydio X2 [50]	3.2	2.9	25.0	0.3	0.10	0.58	1	USA
34	MULTR	DJI	Mavic 3 [51]	12.1	1.1	47.0	10.0	0.83	0.72	1	China
35	MULTR	Height Technolo	MI-3 [52]	24.5	4.2	38.0	6.6	0.27	1.50	2	Netherlands
36	MULTR	Lockheed Martin	Indago 3 [53]	5.0	3.8	46.0	1.3	0.25	1.17	1	USA
37	MULTR	Teledyne FLIR	Skyranger R70 [54]	29.7	4.4	31.0	7.7	0.26	0.98	2	USA
38	MULTR	Ascent Technolo	Spirit [55]	13.5	2.1	60.0	6.5	0.48	0.53	1	USA
39	MULTR	STM	Kargu [56]	17.9	3.2	44.0	2.9	0.16	0.50	1	Turkey
40	MULTR	Inspired Flight	IF800 [57]	16.9	4.4	56.0	6.6	0.39	–	1	USA
41	MULTR	Acecore Technol	Zoe Zetona 8 [58]	26.4	3.1	57.0	4.8	0.18	0.03	2	Netherlands
42	MULTR	Ascent Technolo	NX30 [59]	30.0	3.0	60.0	15.3	0.51	0.62	2	USA
43	MULTR	Performance Dro	C100 [60]	34.0	5.4	45.0	15.0	0.44	1.00	2	USA
44	MULTR	Lucid	Sherpa [61]	35.0	4.0	50.0	–	–	0.33	2	USA
45	MULTR	Wave Aerospace	Falcon II LE [62]	44.0	4.2	72.0	20.0	0.45	1.00	2	USA
46	MULTR	Draganfly	Commander 3 XL [63]	55.0	5.3	45.0	22.0	0.40	0.83	2	Canada
47	MULTR	Wave Aerospace	X-5B Huntress [64]	100.0	6.4	109.0	50.0	0.50	2.00	3	USA
48	MULTR	Free Fly System	Alta X [65]	77.0	7.5	60.0	35.0	0.45	0.83	3	USA
49	MULTR	DJI	Matrice 350 RTK [66]	20.3	2.9	51.5	6.0	0.29	0.92	2	China
50	MULTR	DJI	Matrice 30 [67]	22.1	2.2	51.5	13.1	0.59	0.68	2	China
51	MULTR	DJI	Mavic 2 Enterpr [68]	2.4	1.2	44.7	0.4	0.17	0.52	1	China
52	MULTR	Sony	Airspeak S1 [69]	15.4	2.1	55.9	5.5	0.36	0.37	1	USA
53	MULTR	Draganfly	Heavy Lift Dron [70]	97.0	10.4	49.2	67.0	0.69	0.91	3	Canada
54	MULTR	Sky Drones	X700 [71]	13.2	2.3	37.3	8.8	0.67	1.00	1	UK
55	MULTR	Aerialtronics	Altura Zenith A [72]	21.3	2.0	35.7	6.6	0.31	0.67	2	UK
56	MULTR	Sky Drones	Full Throttle A [73]	22.4	2.2	34.5	13.2	0.59	0.72	2	UK
57	MULTR	Indro Robotics	Wayfinder [74]	44.1	7.5	34.2	33.1	0.75	0.83	2	Canada
58	MULTR	Indro Robotics	Endurance [75]	22.1	2.4	21.8	11.0	0.50	0.67	2	Canada
59	MULTR	Harris Aerial	Carrier H6 [76]	50.7	7.9	33.6	11.0	0.22	5.00	2	USA
60	MULTR	Harris Aerial	Carrier H6 Hydr [77]	55.1	5.3	33.6	11.0	0.20	2.00	3	USA
61	MULTR	Inspired Flight	IF750 [78]	15.0	3.2	40.0	4.6	0.31	0.62	1	USA
62	MULTR	Inspired Flight	IF 1200 [79]	48.5	4.7	49.0	19.0	0.39	0.40	2	USA
63	MULTR	BlueHalo	Intense Eye 2 [80]	13.0	2.5	40.0	3.5	0.27	0.73	1	USA
64	MULTR	Eurolink System	Belugadrone [81]	22.1	3.2	69.3	6.6	0.30	1.00	2	Italy
65	MULTR	Aibotix	X6v2 [82]	14.6	3.4	25.0	4.4	0.30	0.33	1	Italy
66	MULTR	Drone Hopper	X-Quad [83]	66.2	7.0	55.9	44.1	0.67	–	3	Spain
67	MULTR	Drone Hopper	DH-Agro Hopper1 [83]	54.0	7.4	55.9	35.3	0.65	0.17	2	Spain
68	MULTR	T-Drones	MX860 [84]	44.0	2.8	44.7	19.8	0.45	0.67	2	China
69	MULTR	T-Drones	M690 Pro [85]	13.2	3.1	33.6	5.3	0.40	0.92	1	China
70	MULTR	FLIR	R80D SkyRaider [86]	13.8	4.4	31.0	2.8	0.20	0.67	1	USA

Table 4. Data collected for quadplane/tiltrotor (QP/TR) and tailsitter (TAIL) platforms.

No.	Type	Vendor	Model	Weight (lbs)	Size (ft)	Speed (mph)	Pay -load (lbs)	Pay -load frac.	Endur. (hours)	UAS Group	Country
71	QP/TR	Krossblade	Prowler [87]	5.1	3.6	80.0	2.9	0.57	0.92	1	USA
72	QP/TR	Quantum Systems	Trinity F90 [88]	11.0	7.9	38.0	1.0	0.09	1.50	1	Germany
73	QP/TR	Deltaquad	Deltaquad Pro [89]	13.7	7.7	62.6	2.6	0.19	2.00	1	Netherlands
74	QP/TR	C-Astral	SQA eVTOL [90]	22.0	9.5	67.0	2.2	0.10	2.50	2	Slovenia
75	QP/TR	CUAV	Raefly VT260 [91]	30.0	8.7	67.0	5.5	0.18	3.50	2	China
76	QP/TR	Tekever	A3 [92]	55.0	11.5	56.0	8.8	0.16	16.00	2	Portugal
77	QP/TR	Aurora Flight S	SKIRONX [93]	49.0	16.5	58.2	3.2	0.07	3.00	2	USA
78	QP/TR	CUAV	Raefly VT370 [94]	77.0	8.0	60.4	3.3	0.04	10.00	3	China
79	QP/TR	JOUAV	CW-30E [95]	84.0	14.4	56.0	17.7	0.21	8.00	3	China
80	QP/TR	L3 Harris	FVR-90 [96]	120.0	15.4	75.0	32.0	0.27	16.00	3	USA
81	QP/TR	Woot Tech	Alien X VTOL [97]	120.0	15.0	93.0	22.0	0.18	6.00	3	USA
82	QP/TR	Edge Autonomy	VXE30 [98]	44.0	16.0	57.5	5.5	0.13	8.00	2	USA
83	QP/TR	Edge Autonomy	Penguin C Mk 2. [99]	70.0	13.5	74.8	–	–	12.00	3	USA
84	QP/TR	Ukrspec Systems	PD-2 [100]	121.3	16.4	87.0	24.3	0.20	8.00	3	Ukraine
85	QP/TR	Ukrspec Systems	Leleka 100 [101]	12.1	6.5	43.5	1.0	0.08	2.50	1	Ukraine
86	QP/TR	Sky Drones	SkyLane-250 [102]	33.1	8.2	58.2	2.6	0.08	3.50	2	UK
87	QP/TR	Sky Drones	SkyLane-350 [102]	77.2	11.5	62.6	15.4	0.20	5.50	3	UK
88	QP/TR	Sky Drones	Action Drone [103, 104]	26.5	8.2	78.3	4.4	0.17	2.50	2	UK
89	QP/TR	Elevonx	Skyeye Sierra [105]	27.6	10.2	68.3	11.0	0.40	5.00	2	Slovenia
90	QP/TR	Elevonx	Tango VTOL [105]	41.9	9.8	77.7	11.0	0.26	6.00	2	Slovenia
91	QP/TR	Hammerhead	eV20 [106]	176.0	9.5	38.0	44.0	0.25	1.00	3	USA
92	QP/TR	Woot Tech	Firebolt [107]	79.4	9.8	268.4	22.1	0.28	1.00	3	USA
93	QP/TR	Woot Tech	Firefly [108]	37.5	8.9	111.8	6.6	0.18	1.00	2	USA
94	QP/TR	Tekever	A4 [109, 110]	8.8	6.9	33.5	2.2	0.25	2.00	1	Portugal
95	QP/TR	Carbonix	Domani [111, 112]	88.2	14.8	62.6	6.6	0.08	8.00	3	Australia
96	QP/TR	Carbonix	Volanti [113]	35.3	11.8	62.6	2.2	0.06	2.00	2	Australia
97	QP/TR	Aeronautics	Trojan [114]	99.2	13.8	55.9	26.5	0.27	2.50	3	Israel
98	QP/TR	BlueBird	WanderB-VTOL [115]	28.7	10.2	74.8	3.0	0.10	2.50	2	Israel
99	QP/TR	Threod Systems	EOS VTOL UAS [116]	31.1	16.4	66.8	2.4	0.08	3.00	2	Estonia
100	QP/TR	Threod Systems	Stream C VTOL [117]	83.8	12.8	99.0	22.1	0.26	6.00	3	Estonia
101	QP/TR	Soko Aerial	ARACE ROC [118]	29.8	8.2	71.6	5.5	0.19	3.50	2	Ghana
102	QP/TR	Aerovironment	Jump 20 [119]	215.0	18.8	58.0	30.0	0.14	14.00	3	USA
103	QP/TR	Event 38 Unmann	E400 [120]	20.0	9.8	35.7	3.0	0.15	1.50	1	USA
104	QP/TR	T-Drones	VA25 [121]	28.7	8.2	74.6	4.4	0.15	3.50	2	China
105	QP/TR	Flight Wave	Edge 130 Blue [122]	3.4	4.2	65.0	0.8	0.22	2.00	1	USA
106	QP/TR	Aeronautics	Orbiter 4 [123]	121.3	17.1	80.6	26.5	0.22	24.00	3	Israel
107	QP/TR	Lockheed Martin	Stalker XE [124]	30.0	12.0	44.9	5.5	0.18	8.00	2	USA

Table 5. Data collected for fixed-wing (FWNG) platforms.

No.	Type	Vendor	Model	Weight (lbs)	Size (ft)	Speed (mph)	Pay -load (lbs)	Pay -load frac.	Endur. (hours)	UAS Group	Country
118	FWNG	Aerovironment	Raven B RQ-11 [125]	4.4	4.5	50.0	1.9	0.43	1.25	1	USA
119	FWNG	C-Astral	Bramor ppX [126]	10.4	7.5	49.0	2.2	0.21	3.50	1	Slovenia
120	FWNG	Aerovironment	Wasp III [127]	14.4	2.4	40.0	13.3	0.92	0.75	1	USA
121	FWNG	Aerovironment	Puma 3 AE [128]	15.0	9.2	47.0	4.0	0.27	2.50	1	USA
122	FWNG	Black Swift	S2 [129]	20.8	10.0	40.0	5.0	0.24	1.83	2	USA
123	FWNG	Aeronautics	Orbiter 1K [130]	28.7	9.5	57.0	6.6	0.23	2.00	2	Israel
124	FWNG	Textron	Aerosonde Mk 4. [131]	80.0	12.0	74.8	20.0	0.25	14.00	3	USA
125	FWNG	Boeing Insitu	ScanEagle 3 [132]	80.0	13.0	92.0	19.0	0.24	18.00	3	USA
126	FWNG	Aerovironment	T-20 [133]	185.0	17.5	86.0	75.0	0.41	24.00	3	USA
127	FWNG	Northrup Grumma	Bat UAS [134]	210.0	12.0	102.0	75.0	0.36	8.00	3	USA
128	FWNG	Resolute ISR	Resolute Eagle [135]	300.0	18.2	143.0	100.0	0.33	12.00	3	USA
129	FWNG	Ukrspec Systems	Shark UAS [136]	27.6	11.2	80.8	1.0	0.04	4.00	2	Ukraine
130	FWNG	Ukrspec Systems	Mini Shark [137]	11.0	6.6	74.6	1.0	0.09	2.00	1	Ukraine
131	FWNG	ElevonX	Skyeye Delta [138]	13.8	7.5	62.1	4.4	0.32	3.50	1	Slovenia
132	FWNG	ElevonX	Skyeye Sierra [138]	27.6	9.8	77.7	11.0	0.40	8.00	2	Slovenia
133	FWNG	AgEagle	eBee X [139]	3.5	3.8	68.3	1.8	0.50	1.50	1	USA
134	FWNG	EMT	Aladin [140]	8.8	4.8	55.9	1.6	0.19	–	1	Germany
135	FWNG	Lockheed Martin	Desert Hawk III [141]	10.2	4.9	57.5	2.0	0.20	1.50	1	USA
136	FWNG	Lockheed Martin	Desert Hawk IV [141]	10.2	4.9	63.3	2.0	0.20	2.50	1	USA
137	FWNG	Lockheed Martin	Desert Hawk EER [141]	24.0	12.0	40.3	6.0	0.25	10.00	2	USA
138	FWNG	EMT	Luna X-2000 [142]	88.0	13.7	43.0	44.0	0.50	8.00	3	Germany
139	FWNG	IDETEC	AG-Wing [143, 144]	4.2	5.1	46.6	1.3	0.32	0.75	1	Chile
140	FWNG	Aeronautics	Orbiter 2 [145]	28.7	9.8	57.5	4.0	0.14	3.00	2	Israel
141	FWNG	Aeronautics	Orbiter 3 [146]	70.6	14.4	80.6	12.1	0.17	6.00	3	Israel
142	FWNG	Aeronautics	Orbiter 5 [147]	165.4	21.0	80.6	55.1	0.33	25.00	3	Israel
143	FWNG	IDS Corporation	IA-17 Manta [148]	55.1	9.2	124.3	5.5	0.10	5.00	3	Italy
144	FWNG	Aircraft Trader	Guaridan Eye [149]	13.2	7.2	99.4	4.4	0.33	4.00	1	Belgium
145	FWNG	National Chung-	Cardinal II [150]	13.0	6.2	34.0	4.0	0.31	–	1	Taiwan
146	FWNG	L3 Harris	Cutlass [151]	15.0	4.6	97.8	3.0	0.20	1.00	1	USA
147	FWNG	Aeroland	AL-4 [152]	9.3	6.6	62.0	2.2	0.24	1.00	1	China
148	FWNG	WB Group	Flyeye mini UAV [153]	26.5	11.8	74.6	4.4	0.17	2.50	2	Poland
149	FWNG	Survey Copter	Tracker 120 [154]	19.2	10.8	55.9	2.4	0.13	1.50	1	France
150	FWNG	Aerofoundry	Watupa-e [155]	22.1	15.1	31.1	4.4	0.20	6.00	2	Brazil
151	FWNG	ZALA	421-08 [41, 156]	4.6	2.7	80.8	0.7	0.14	1.67	1	Russia
152	FWNG	ZALA	421-04M [41]	9.3	5.2	74.6	2.2	0.24	2.00	1	Russia
153	FWNG	ZALA	421-16 [41]	39.7	5.3	93.2	6.6	0.17	7.00	2	Russia
154	FWNG	C-Astral	Bramor C4EYE [157]	10.4	7.5	67.1	2.2	0.21	3.50	1	Slovenia
155	FWNG	FT Sistemas	FT-100 [158]	15.4	8.9	38.0	6.6	0.43	2.00	1	Brazil
156	FWNG	Event 38 Unmann	E384 [159]	5.6	6.2	45.0	4.0	0.71	1.50	1	USA
157	FWNG	Event 38 Unmann	E386 [160]	5.6	6.2	45.0	1.1	0.20	1.42	1	USA
158	FWNG	ZOHD	Talon Rebel [161]	2.8	3.3	62.1	–	–	–	1	China
159	FWNG	EADS Cassidian	Tracker / DRAC [162]	18.7	11.8	62.1	2.2	0.12	1.50	1	France
160	FWNG	Lockheed Martin	Stalker XE [124]	48.0	16.0	58.0	5.5	0.11	8.00	2	USA
161	FWNG	SPE Athlon Avia	A1-S Furia [163]	12.1	6.4	62.1	–	–	3.00	1	Ukraine
162	FWNG	STM	Alpagut [164, 165]	121.3	8.2	223.7	24.3	0.20	1.00	3	Turkey
163	FWNG	Tekever	AR1 Blue Ray [166]	16.4	5.9	34.2	–	–	3.00	1	Portugal
164	FWNG	Tekever	AR4 Light Ray C [167]	6.6	3.6	36.0	–	–	0.75	1	Portugal
165	FWNG	Tekever	AR4 Light Ray E [168]	6.6	3.6	49.7	–	–	0.75	1	Portugal
166	FWNG	Baykar	Bayraktar Mini [169]	32.5	6.6	46.0	–	–	1.33	2	Turkey
167	FWNG	Blue Bear Syste	Blackstart [170]	16.4	4.9	74.6	–	–	1.00	1	UK
168	FWNG	Raytheon	Coyote [171]	21.0	4.8	97.6	–	–	1.50	2	USA
169	FWNG	Leonardo Airbor	CREX-B [172]	6.9	5.6	68.3	–	–	1.25	1	Italy
170	FWNG	Integrated Dyna	Desert Hawk [173, 174]	14.8	4.9	62.1	–	–	1.00	1	Spain
171	FWNG	Israel Aerospac	Green Dragon [175, 176]	49.2	5.6	230.0	–	–	1.25	2	Israel
172	FWNG	MicroUAV	HawkMoth [177]	13.4	6.5	103.8	–	–	2.00	1	USA
173	FWNG	Sky-Watch	Heidrun V1 [178]	7.2	5.4	66.5	–	–	–	1	Denmark
174	FWNG	UVision	HERO-120 [179]	27.6	2.0	74.6	7.7	0.28	1.00	2	Israel
175	FWNG	Irkut Engineeri	Irkut-3 [180]	9.8	6.6	55.3	–	–	1.25	1	Russia
176	FWNG	BlueBird Aero S	MicroB [181, 182]	2.2	3.1	51.8	0.5	0.24	1.00	1	Israel
177	FWNG	Innocon	MicroFalcon LP [183]	13.2	5.9	74.6	4.4	0.33	2.00	1	Israel
178	FWNG	Sparkle Tech	Pigeon [184]	4.2	3.9	62.1	1.1	0.26	1.50	1	China
179	FWNG	Integrated Dyna	Pride [185]	9.9	5.0	62.1	1.1	0.11	1.00	1	Spain
180	FWNG	UCONSYSTEM	REMOEYE-002B [186, 187]	11.2	5.9	49.7	–	–	1.00	1	South Korea
181	FWNG	Integrated Dyna	Rover Mk I [188]	6.6	4.9	62.1	–	–	0.75	1	Spain
182	FWNG	Integrated Dyna	Skycam-W [189]	5.5	3.3	60.0	1.1	0.20	1.50	1	Spain
183	FWNG	Skywalker	Skywalker X6 [190, 191]	4.4	4.9	24.9	–	–	0.42	1	China
184	FWNG	Blackbar Engine	STORM [192]	12.0	7.6	112.8	–	–	1.33	1	USA
185	FWNG	IPCD	Tactical UAV [193]	4.4	5.6	49.7	–	–	0.75	1	Indonesia
186	FWNG	Lockheed Martin	Vector Hawk [194]	4.0	3.6	80.8	0.8	0.19	1.17	1	USA
187	FWNG	WB Group	Warmate [195, 196]	12.6	4.6	93.2	3.1	0.25	0.83	1	Poland
188	FWNG	Innocon	MicroFalcon LE [197]	22.1	6.6	74.8	4.4	0.20	4.00	2	Israel