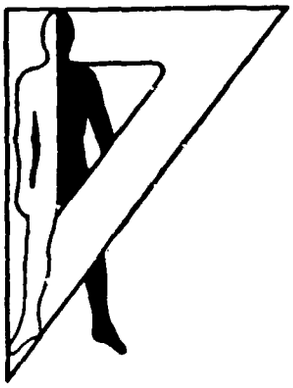

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Technical Memorandum 4-88

FOUR-AXIS SIDE-ARM FLIGHT CONTROL SIMULATOR INVESTIGATION

William B. DeBellis

May 1988
AMCMS Code 612716.H700011

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U. S. ARMY HUMAN ENGINEERING LABORATORY

Aberdeen Proving Ground, Maryland

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Memorandum 4-88	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Human Engineering Laboratory 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Aberdeen Proving Ground, Maryland 21005-5001	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 6.27.16.A PROJECT NO. 1L162716AH70 TASK NO. WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

FOUR-AXIS SIDE-ARM FLIGHT CONTROL SIMULATOR INVESTIGATION

12. PERSONAL AUTHOR(S)
William B. DeBellis

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM _____ TO _____	May 1988	27

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Flight control, Multiaxis control, Helicopters, CB protective clothing
01	03	01	
01	04		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report presents the results of the second in a series of investigations to compile a data base on multiaxis side-arm flight controls. This second investigation focused on the effects that wearing a large and relatively bulky chemical and biological protective glove had on the pilots' flight performance, while they were using the multiaxis flight control. Pilots were allowed to adjust the position of the armrest and the controller for individual comfort. A multivariate analysis of variance (MANOVA) was performed using three different arrangements of controller and armrest and two levels of clothing.

(See reverse side)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED XX SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Doris S. Eanes	22b. TELEPHONE (Include Area Code) 301-278-4478 22c. OFFICE SYMBOL SLCHE-SS-TS

DD Form 1473, JUN 86 *Previous editions are obsolete.* SECURITY CLASSIFICATION OF THIS PAGE

19.

In general, the root-mean-square deviation measure was not able to detect a consistent statistically significant difference between the three levels of controller/armrest arrangement or the two levels of clothing across all flight phases at the 5-percent level. This was true for both aircraft performance measures and pilot input measures. There were also no statistically significant interactions detected between these dependent measures. Additional data analysis showed that there were statistically significant differences on individual pilot performances and pilot to dependent measure interaction. Keywords: Flight control systems, Helicopters, (SDW)

AMCMS Code 612716.H700011

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CONTENTS

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INTRODUCTION

This report presents the results of the second in a series of investigations to compile a data base on multiaxis side-arm flight controls. This second investigation focused on the effects that wearing a large and relatively bulky chemical and biological protective glove had on the pilots' flight performance, while they were using a multiaxis flight control. Pilots were allowed to adjust the position of the armrest and the controller for individual comfort. The long-range goal is to provide design criteria that integrates multiaxis flight controls into future Army crewstations and increases pilot effectiveness using these devices. This will be accomplished through design recommendations and inputs to military specifications and standards.

BACKGROUND

Through the combined efforts of private industry and government agencies, a single multiaxis side-arm flight control has shown that it can control the flight of a helicopter. The concern is that since both the controller and the armrest are fixed in location and attitude, these conditions may not be suitable for the full range of pilots, which could induce fatigue during extended flight.

The Human Engineering Laboratory (HEL) at Aberdeen Proving Ground, Maryland, through the use of its simulation and computer facilities, has designed a series of tests to fill voids in the data and to determine if a multiaxis side-arm flight control concept is operationally beneficial for the Army.

As a result of an initial investigation (DeBellis & Christ, 1986), the physical attitude, the rotation, and the location of the controller and the armrest inside the crewstation were determined, based on subjective comfort. Data were gathered on left- and right-handed personnel, male and female personnel, and on pilots wearing and not wearing chemical and biological (CB) gloves.

OBJECTIVES

The objectives of this investigation were to

(a) determine the effects of changing the physical position of the armrest and the multiaxis controller for the pilot's personal comfort during a simulator flight.

(b) determine the effects on pilots wearing a CB protective glove during a simulator flight.

(c) investigate the control-input cross-coupling effects based on the different armrest and controller positions and the wearing of a CB protective glove.

METHOD

Description of Apparatus

A motion-base Link General Aviation Helicopter Trainer (GAT-2H) simulator was used in this investigation. The GAT-2H is representative of a UH-1H helicopter with a Lycoming T53-L-13 engine and transmission installation.

Figure 1 shows the test setup of the armrest and the controller for installation into the simulator crewstation. Both the armrest and the multiaxis controller could be adjusted in rotation and position with respect to each other and with respect to the seat reference point (SRP) as defined by MIL-STD-1333A (1977).

Figure 2 shows the multiaxis controller used during this investigation. It is a small deflection force controller with the characteristics described in Table 1. The design is not based on any specific Army requirement and was purchased off the shelf.

Table 1

Controller Characteristics[a]

Parameters	Control inputs		
	Pitch & Roll[b]	Collective	Yaw
Force over linear range (±)	20 lb	40 lb	60 in.-lb
Maximum allowed force (±)	160 lb	528 lb	1056 in.-lb
Sensitivity (±10%)	0.5 V/lb	0.3 V/lb	0.17 V/in.-lb
Deflection at maximum force (±)	0.4 in.	0.1 in.	4 deg/in.-lb

[a]Model 404-G717, Measurement Systems Inc.
[b]Pitch and roll inputs are the same values.

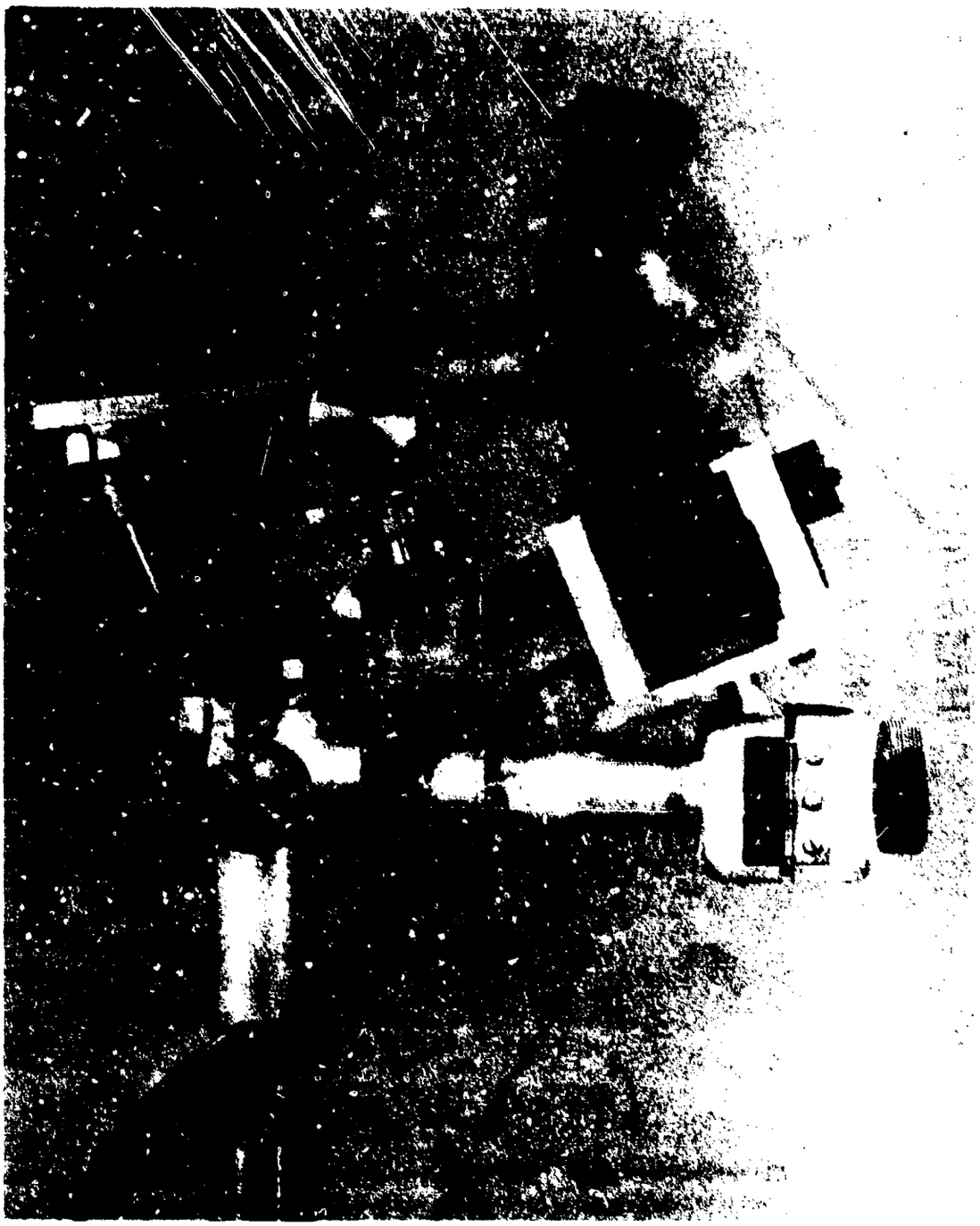

Figure 1. Setup of test equipment.

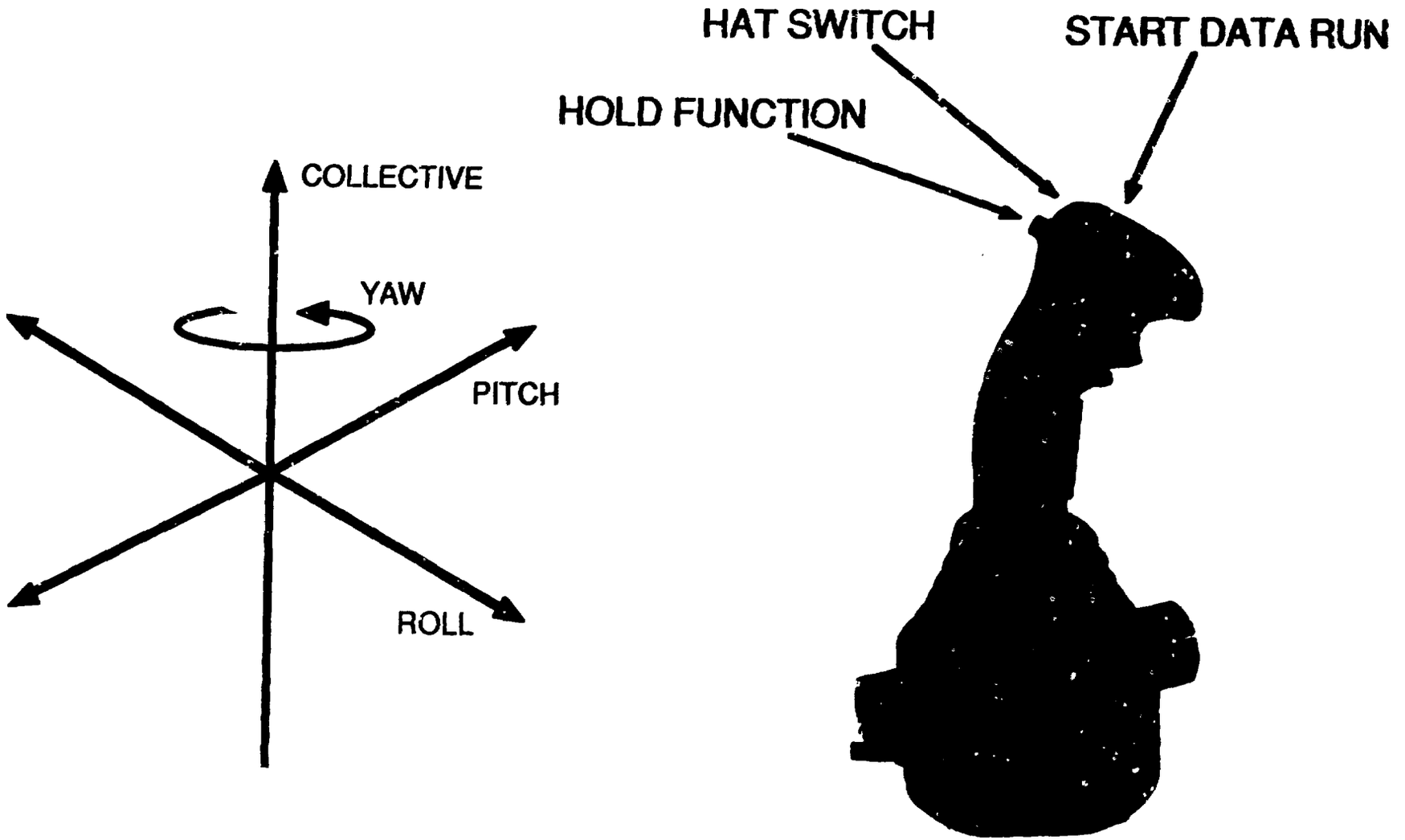

Figure 2. Multiaxis controller.

Flight attitudes were controlled by

- Roll--controlled with side-to-side forces
- Pitch--controlled with fore-to-aft forces
- Collective input--accomplished by pulling and pushing along the vertical z-axis
- Yaw (antitorque)--accomplished by twisting about the z-axis.

The antitorque twisting motion was reversed from a normal pedal input in that a clockwise twist caused the simulator to rotate in a clockwise direction as opposed to pressing the right pedal, which was a counterclockwise motion. This was selected as the appropriate performance-related control-display relationship.

An antitorque-airspeed stability function was used in the computer software to unburden some of the tasks of the pilot. This was accomplished by setting a specific helicopter gross weight, center of gravity location, and rotor speed. The function was generated by recording the required antitorque signals; these signals were needed to maintain the simulator in coordinated conditions as it was flown from lift-off through ground effect and transition to maximum airspeed. The antitorque-airspeed function was automatically generated so that the pilot did not need to provide any yaw inputs when coordinated flight was required. When an uncoordinated yaw condition was required, the pilot provided a control input, and relaxed the pressure on the controller. The new attitude would then hold until it was changed again.

Additionally, both the trim and the parameter-hold functions were available when the pilot did not need to hold pressure against the controller. Normal pitch and roll inputs were accomplished when the pressure was applied proportionally to an actual displacement of a conventional cyclic control. With the trim function, the pilot used the hat switch to change the pitch and roll condition instead of using the controller itself. The trim function was integrated in force and time in that more of a change would result with a longer and/or harder operation of the switch.

The collective inputs and pedal inputs were similar to the trim function in that input was integrated in both force and time. A pilot applied pressure until the desired condition was obtained, then released the pressure and the condition would be maintained until changed.

The upper left button switch was used for the parameter-hold function. The pilot flew the simulator into the desired conditions, pressed the switch, released the pressure, and all the conditions would hold until changed. The parameter-hold functions were similar to the attitude-hold functions used in other simulators except that when the pilot would release controller pressure before the vehicle stabilized.

the attitude of the simulator would continue to adjust to changing conditions (e.g., airspeed) until stabilized.

Figure 3 shows the display format. The layout is based on keeping the center of the screen fairly clean because the symbology is meant to overlay a video or a forward-looking infrared (FLIR) image. The symbology was generated with two features that rendered it more useful and pleasing. First, the alphanumerics were sized to be greater than 20 minutes of arc at a 28-inch viewing distance. Second, as the moving scale numbers approached the ends of their windows, their brightness gradually decreased so that new characters did not instantaneously come into or go out of view. This drew unnecessary attention to them as the flight parameters changed. A PDP® 11-34 computer and a Vector General® graphics system generated the display format. The display itself was stroke-written and was white on black.

Figure 4 shows the modified Bravo flight pattern the pilots used during the investigation. It is a pattern that was flown without an outside visual scene. A DECtalk® voice synthesizer provided the appropriate voice commands to the pilot to change radio frequencies. This served as a secondary task by diverting the attention of the pilot from the vertical situation display. The three voices used were different and not any of the seven default DECtalk® voices. The use of a synthesized voice allowed for a voice that was consistent but different in tone to present the messages to each pilot. It also allowed the message timing to be precisely controlled. Table 2 lists the messages that were relayed to the pilot.

A VAX® 11/780 computer controlled the experiment and all programming was done in FORTRAN. Sixteen channels of analog data were recorded every half second with data being transferred back and forth between the computer and the simulator 60 to 100 times a second, depending on the subroutines being used by the main program.

Experimental Design

The experimental design was a 3 x 2 factorial design shown in Table 3. Each subject was given all treatments in accordance with Table 4. The dependent variables were root-mean-square (RMS) deviations on flight path, helicopter attitude, and controller motion. The parameters used were heading, altitude, airspeed, rate-of-climb, pitch, roll, cyclic pitch, cyclic roll, collective, and antitorque. A combination or a weighted combination of these parameters was not used. A MANOVA was performed for each of the dependent variables on separate path segments.

Figure 3. Display format.

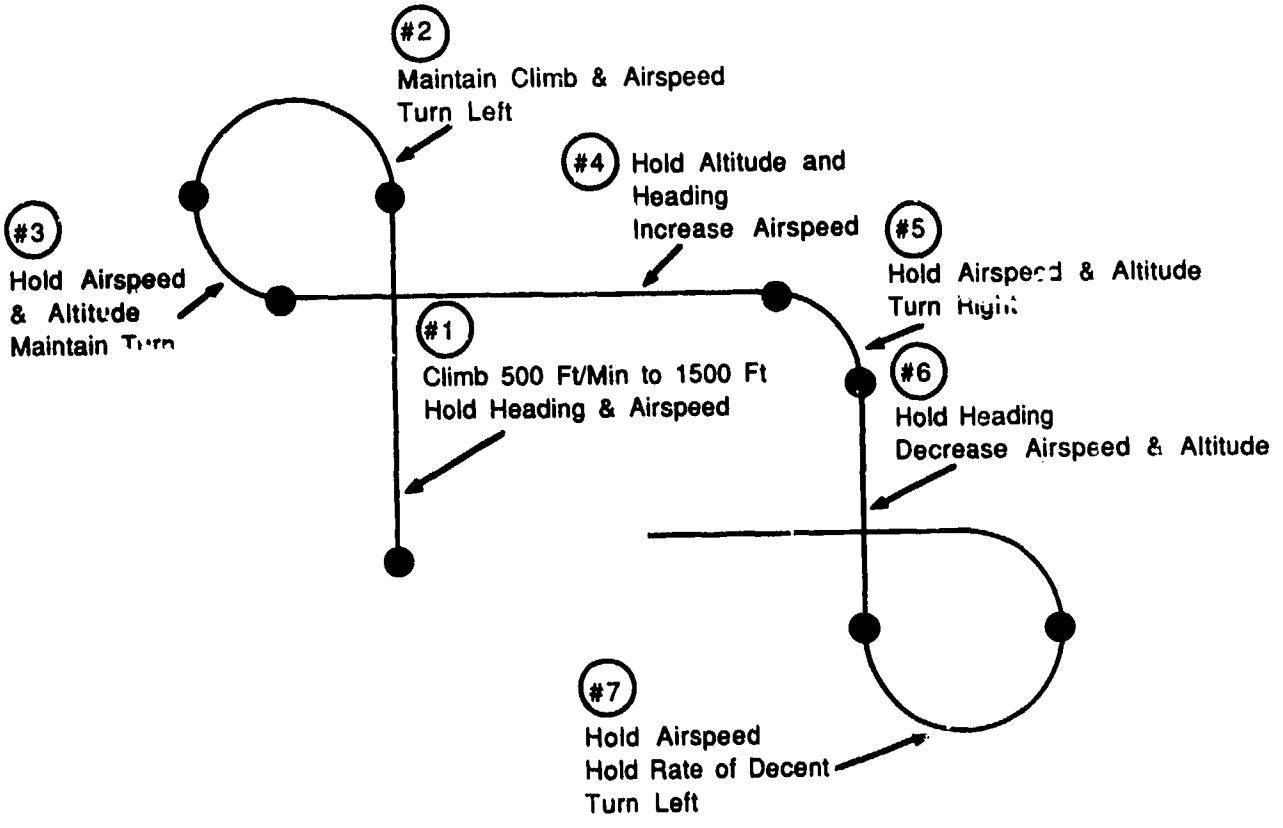

Figure 4. Modified bravo flight pattern.

Table 2

Scenario

Bravo pattern instructions	Time	Voice message content
(1) Helicopter on ground heading 030		
(2) Start up		(voice #1)
(3) Contact ground control	~ -3.0	(1) Army 227 cleared for takeoff, turn left to a heading of 360, level off at 500 feet at 80 knots, contact VAX control on 123.225
(4) Climb to 500 feet, 80 knots, heading 360		
(5) Level off, press button to start		
(6) Climb 500 feet per minute for 1 minute	Start	
	0.5	(2) Army 227, this is VAX control, contact Colt on 128.5. Have a good flight
		(voice #2)
		(3) Roger Army 227, continue flight
(7) Turn left 270 degrees, maintain climb to 1500 feet	1.0	
	2.2	(4) Army 227, change frequency to 125.5
(8) Increase airspeed to 100 knots, maintain heading for 1 minute	2.5	
(9) Turn right 90 degrees, maintain airspeed and altitude	3.5	
	3.7	(5) Army 227, change frequency to 121.225
(10) Descend to 1000 feet, decrease airspeed to 60 knots	4.0	
(11) Turn left 270 degrees, maintain airspeed and altitude	5.0	
(12) Descend to 100 feet above ground level, maintain airspeed	6.5	
	7.0	(6) Army 227, contact SENTINEL control on 127.5
		(voice #3)
		(7) Roger Army 227, continue flight
	8.0	(8) Army 227, we have you in sight. Please come to a 10-foot hover on a heading of 360 and hold
(13) Hover and land	9.0	(9) Army 227, thank you for holding, you may land

Table 3

Experimental Design

Conditions	x1	x2	x3
y1	A	B	C
y2	D	E	F

Note: x1 - controller and armrest - fixed
x2 - armrest - fixed; controller - adjustable
x3 - controller and armrest - adjustable
y1 - pilot wearing flight glove
y2 - pilot wearing a flight and CB glove

Table 4

Presentation Order

Subjects	Order					
1	A	B	F	D	C	E
2	B	C	A	E	D	F
3	C	D	B	F	E	A
4	D	E	C	A	F	B
5	E	F	D	B	A	C
6	F	A	E	C	B	D
7	A	B	F	D	C	E
8	B	C	A	E	D	F
9	C	D	B	F	E	A
10	D	E	C	A	F	B
11	E	F	D	B	A	C
12	F	A	E	C	B	D

Subjects

Twelve male pilots from Phillips Army Airfield, Aberdeen Proving Ground, Maryland, were used as test participants during the investigation. Their demographic data are listed in Table 5. All pilots were on flight status and screened through direct questioning before each test session.

Table 5

Subject Data

Subject	Grade	Age	Years of service	Flight hours Fixed	Rotary	Total	Ranking scores
1	CW2	37	03	800	1200	2000	a
2	CPT	36	13	350	3200	3550	198
3	CW3	38	15	1500	4500	6000	170
4	CW4	43	18	100	5200	5300	a
5	CW4	45	18	3000	5000	8000	138
6	CPT	33	09	0	1500	1500	099
7	DAC	45	20	2500	3000	5500	131
8	CW4	38	18	3000	4000	7000	126
9	CPT	32	08	400	1600	2000	114
10	MAJ	39	14	0	1000	1000	127
11	MAJ	39	20	-	-	-	141
12							b

[a]Did not meet training criteria
[b]Withdrew from the experiment

Procedures

Initially, the purpose of the investigation and the procedures were explained to each pilot and the necessary consent forms were signed. Training started with the pilots getting used to the simulator with the motion off and the experimenter standing by to answer any questions. As the pilots became more proficient, the motion was turned on and the pilots practiced on the modified Bravo pattern without the active voice system. After 1-1/2 to 2 hours of training, depending on the individual pilot, the voice system was turned on and two test runs were taken exactly like the actual data run.

For the actual data run, the experimenter started the program with the simulator on the ground at operational RPM (revolutions per minute). The first voice message started and the pilot lifted off and attained the indicated flight conditions. When the pilot felt that he was ready to proceed, he pressed the upper right button on the controller, which initiated the rest of the voice messages and the start of data collection. The pilots could use any of the features available on the controller and were not restricted to a particular mode of stability. Radio frequency changes were done with the left hand.

Each data run lasted less than 15 minutes with a 10-minute break between runs.

RESULTS

The flight path was broken up into seven phases that were analyzed with separate MANOVAs on both aircraft performance measures and pilot control input measures. The actual numbers being analyzed were analog-to-digital conversion values between 0 and 4096, which represented voltages between plus and minus 10 volts. These were then transformed with a "log10+1" since a preliminary check on the data showed a high correlation between the means and the variances. Data that occurred outside three standard deviations were deleted and the degrees of freedom adjusted accordingly. The full data tables are in the Appendix with summary data in Table 6. Table 6 shows the results of the analysis on main effects.

In general, the root-mean-square deviation measure was not able to detect a consistent statistically significant difference between the three levels of the controller-armrest arrangement (CAA) or the two levels of glove (G) across all flight phases at the 5-percent level. This was true for both aircraft performance measures and pilot input measures. There were also no statistically significant interactions detected between these dependent measures. Additional data analysis showed that there were statistically significant differences on the individual pilot performances and the pilot to dependent measure interaction.

Of interest is the fact that differences in the effects of glove and CAA did not show up until the second half of the simulator flight. Flight phases four and six had airspeed changes which might have been a more demanding task than turns and altitude changes.

During flight phase four, the pilot was required to hold altitude and maintain a heading while increasing airspeed. An analysis of the relative means showed that rate-of-climb error, collective activity, and yaw activity were significantly less when the armrest was in the same fixed position for all subjects and when the controller was adjusted for individual comfort. The actual controller pitch activity showed no significant differences across the effects of comfort, and there was no glove effect on any measure that indicated a uniqueness to the interaction.

During flight phase five, there was no airspeed change, but there was a simple right turn while holding altitude; there was a significant difference in helicopter altitude variability across both the effects of CAA and glove. Controller activity does not indicate a cross-coupling effect, but a comment made by a pilot about this flight condition lends some insight. The pilot reported that a right turn was more difficult because his right thumb was the only digit applying pressure against the handgrip. A fixed controller with a fixed armrest was the worst condition in controlling altitude. Differences between the other two conditions were not significant.

Table 6

Analysis of Main Effects
(F-ratio)

Main effect	Parameter	Flight phases 1	2	3	4	5	6	7
Glove	HD	0.04	1.32	2.47	0.02	0.18	0.41	0.17
	ALT	1.85	1.44	0.55	0.43	6.24[a]	2.19	0.38
	AS	0.08	0.58	0.45	0.01	1.67	2.35	0.02
	ROC	0.09	0.01	0.09	0.00	0.07	0.17	2.59
	PIT	0.06	0.01	0.96	1.40	2.63	8.04[a]	1.03
	ROL	0.39	0.64	0.09	0.07	0.01	b	0.00
	CPIT	3.11	0.06	0.24	0.73	0.31	1.52	0.82
	CROL	0.24	0.09	0.01	0.16	1.38	0.04	0.09
	COLL	0.05	0.30	0.14	0.29	0.00	0.02	1.40
	YAW	0.25	0.05	1.14	2.29	3.79	0.30	1.00
Controller/ armrest arrangement (CAA)	HD	0.88	0.99	0.72	0.93	0.11	1.49	0.05
	ALT	0.68	0.17	0.13	2.43	6.38[a]	0.55	0.59
	AS	0.33	0.30	0.55	1.02	0.56	0.22	0.70
	ROC	1.85	0.71	1.59	4.32[a]	8.30[a]	0.79	1.95
	PIT	0.92	0.17	1.85	0.41	0.14	1.76	0.17
	ROL	0.01	0.31	0.11	1.83	0.72	b	1.58
	CPIT	0.84	0.09	1.05	0.09	0.73	1.67	0.64
	CROL	0.13	0.15	0.61	3.37	0.18	0.67	0.11
	COLL	2.52	0.15	1.05	4.24[a]	3.14	0.32	2.52
	YAW	0.17	0.14	1.55	3.95[a]	0.11	0.24	1.73

[a]Significant at the .05 level
[b]Lost roll signal

Note: The parameters are

HD = heading
ALT = altitude
AS = airspeed
ROC = rate-of-climb
PIT = pitch
ROL = roll
CPIT = fore-and-aft motion on the controller
CROL = side-to-side motion on the controller
COLL = collective
YAW = yaw

During flight phase six, the pilots were asked to decrease altitude while decreasing airspeed. Here, helicopter pitch variability while not wearing a CB glove was significantly worse than while wearing a CB glove.

Table 5 shows the relationship between pilot flight time and performance in this investigation. In general, pilots with many hours of flight time performed worse than pilots with little flight time. Two of the pilots were having difficulty with the controller during training and as a result were frequently off the flight pattern. They did not participate in the actual data runs because training could not be completed.

The ranking scores contained in the last column in Table 5 were based on the ability to maintain flight parameters. Altitude, airspeed, rate-of-climb, heading, pitch, and roll were all weighted equally and summed across all flight phases. Using flight parameters only, rankings were calculated by giving the lowest RMS error a value of 1 per pilot and flight segment. These were then summed across flight parameters and flight segments for each pilot. As an example, subject pilot #6 was ranked the best with the lowest score, and subject pilot #2 was ranked the worst.

Both the flight parameters and control variable rankings showed that the condition with a fixed armrest and an adjustable controller was best when no glove was worn. However, when a CB glove was worn, the rankings for control variables indicated that this condition was worse while the flight parameter rankings still showed it to be best.

DISCUSSION

The most perplexing problem in this investigation was the inconsistent pilot responses during each of the trials. The pilots changed their strategy to maintain their aircraft attitude as if to test which way the simulator should be flown to minimize all flight profile errors detected. All the pilots trained the same amount and seemed to perform consistently during their training period. However, when actual data were to be taken, they started to adjust the way they were flying in order "to beat the system." In effect, the airspeed, heading, and altitude were not consistently adjusted between and within the pilot variable. Any possible true differences were lost in the experimental error.

Conversely, the variations in pilot performance might not have been great enough to hide true differences. The null hypothesis might have indeed been met yielding the conclusion that a pilot can wear a CB glove and adjust the controller and armrest for comfort without demonstrating a statistical difference in performance.

The actual criteria each pilot subjectively accepted as having met the flight pattern conditions were different. For example--when

considering altitude, one pilot may accept +/- 25 feet as being close enough while another will work toward +/- 10 feet. In effect, prior training in instrument flying may have contributed to the error in this investigation. No one crashed, but the needle was not threaded in all cases and the RMS flight path error might not have been the best indication of pilot performance. A subjective measure was contemplated, but it was unknown whether line pilots could provide the needed answers or try to make a less than optimal situation work to their advantage.

Along with the inconsistency in performance, how each pilot held the controller was considered. Some pilots held the grip firmly while others held it in their fingertips. One pilot was, at times, holding the controller with his hand on top of the control head. When asked why, it was because this was his normal resting position. Again, this was not a consistent position for his hand.

Some of the error could have been reduced through more training; however, prior experience with local simulator investigations indicated that attempts at training to a stable performance level induced pilot fatigue and lack of interest, causing an increase in experimental error. In addition, increasing the amount of time subjects spent away from their primary job increased scheduling difficulties and decreased the number of subjects willing to give up time for the investigation.

CONCLUSIONS

In general, the controller-armrest arrangement yielding the best results, although not statistically significantly different, was the controller adjusted for individual comfort and a fixed armrest.

The effects of pilots changing their flight strategy, how they held the controller inconsistently, and how closely they flew the flight pattern confounded the results.

The RMS measure is not sensitive enough to detect significant differences in flight performance and the cross-coupling effects could not be determined.

This investigation has shown that a helicopter can be flown while wearing a CB glove with the controller attitude adjusted for individual comfort. It has not shown nor was it intended to show that flying a helicopter with a multiaxis side-arm flight control is significantly different from flying a helicopter with conventional controls.

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APPENDIX

EXPERIMENTAL DATA

	EXPERIMENTAL CONDITIONS				HELICOPTER PARAMETERS						CONTROL INPUTS			
	P	B	CAA	SUBJ	HD	ALT	AS	ROC	PITCH	ROLL	CYC-PIT	CYC-ROLL	COLLECTIVE	YAW
1	1	1	1	2	2.5777	1293.59	516.1	2983.7	8049	13695.5	18811	59433	578.64	4658.3
2	1	1	1	3	6.2414	2217.85	3518.2	3618.3	13923	5879.9	17678	16537	848.77	14638.9
3	1	1	1	5	8.6496	1472.85	1659.2	56548.8	6928	5865.3	33314	21488	1865.93	4873.4
4	1	1	1	6	8.9961	3625.62	681.8	831.7	2928	153.2	2418	1136	197.88	4572.7
5	1	1	1	7	22.4889	2527.18	4382.3	233.8	13155	13853.8	43528	225861	236.99	13789.3
6	1	1	1	8	8.7819	2783.19	1516.1	3199.5	5398	2689.8	7843	9681	672.84	12457.7
7	1	1	1	9	1.3528	2745.33	347.5	1842.2	4277	638.7	8818	2639	214.88	123.9
8	1	1	1	10	8.9876	2828.69	648.4	3793.9	6417	2519.8	6466	18927	1673.53	516.5
9	1	1	1	11	4.6388	2451.69	286.8	569.2	1639	294.7	1611	3356	284.64	5986.2
10	1	1	2	2	17.1192	4272.34	2586.4	11676.8	28159	19327.9	43168	78662	1843.48	7364.6
11	1	1	2	3	25.2691	1575.21	1184.1	1167.1	6781	8388.6	18748	32385	572.38	25917.9
12	1	1	2	5	2.3638	3518.82	321.3	7227.6	3635	2148.2	18892	19415	678.48	356.1
13	1	1	2	6	2.8466	2324.67	1264.2	2748.2	9187	546.1	5246	3295	918.31	14487.5
14	1	1	2	7	9.6755	3869.96	5972.2	2829.3	11416	5939.8	168845	41859	321.28	16583.3
15	1	1	2	8	1.8167	1638.28	3443.8	2695.8	7971	2682.8	112487	47478	558.11	11294.8
16	1	1	2	9	8.5418	3632.59	187.8	2659.1	2765	2823.4	5885	9343	321.13	468.2
17	1	1	2	10	8.4831	3475.79	561.8	3497.9	7854	2273.5	9854	18284	754.64	578.3
18	1	1	2	11	8.7447	2669.23	132.4	191.4	483	355.1	295	1876	15.38	73.5
19	1	1	3	2	5.7649	3473.19	9982.8	5623.3	29983	15979.2	62277	75728	711.38	15481.6
20	1	1	3	3	1.7684	2511.43	366.6	2182.2	4888	1498.7	8128	6229	688.88	5991.8
21	1	1	3	5	2.8573	1546.81	1784.6	6767.2	8578	3433.3	16369	16577	1899.13	1623.2
22	1	1	3	6	8.2149	2243.54	262.7	998.1	2937	281.7	3865	1187	494.97	2493.1
	1	1	3	7	2.6129	4881.11	2941.8	1854.8	9211	2942.1	13638	16798	117.52	991.8
24	1	1	3	8	8.7481	1379.89	499.1	18481.8	1326	1858.2	2471	9686	1188.62	8175.1
25	1	1	3	9	1.8158	2735.82	313.1	3835.9	2688	1642.9	5894	21745	588.32	699.9
26	1	1	3	10	8.5136	3812.44	1219.2	3523.3	9979	2229.7	9889	18289	393.34	331.2
27	1	1	3	11	5.9991	3687.34	1491.9	585.2	11228	5183.3	49984	24968	139.82	5383.5
28	1	2	1	2	14.9818	1868.18	31828.1	6991.9	143585	57138.8	1191963	211356	1163.66	47735.3
29	1	2	1	3	6.5961	2619.48	1545.8	13259.9	7183	11328.8	12252	39622	1246.27	18158.8
30	1	2	1	5	1.8447	3186.38	631.1	13516	5138	1736.8	6118	7255	159.93	389.8
31	1	2	1	6	1.2583	2879.39	681.8	536.2	3849	431.8	1686	1249	227.32	5132.1
32	1	2	1	7	3.8159	1529.12	2484.6	2689.9	7588	2768.4	15742	25641	95.58	769.6
33	1	2	1	8	2.5288	2486.26	912.3	7687.4	3221	1757.9	4388	18266	1413.78	17477.6
34	1	2	1	9	8.9614	2882.44	219.8	382.5	3543	1461.8	4681	6485	189.82	181.7
35	1	2	1	10	2.8368	2877.13	962.8	1353.3	5292	3538.5	5884	17881	196.91	831.9
36	1	2	1	11	2.8887	3628.45	617.3	484.8	3463	1949.8	3226	7454	131.76	436.9
37	1	2	2	2	4.7855	8129.81	586.2	13522.3	14454	18597.8	24195	81228	2581.91	8442.8
38	1	2	2	3	3.8186	4249.24	226.3	2242.9	2494	2193.3	4414	9538	689.77	15138.5
39	1	2	2	5	21.3252	4487.92	1192.4	4985.1	5883	4528.6	19888	62388	521.21	1636.4
40	1	2	2	6	8.7465	2755.21	1218.6	1281.2	3888	364.4	3823	1639	178.36	6896.4
41	1	2	2	7	9.2361	3478.61	2772.5	1831.8	7888	4359.9	38775	23566	485.54	5771.9
42	1	2	2	8	8.4721	1458.71	4475.2	6616.5	7485	2138.2	11588	18738	924.25	18816.1
43	1	2	2	9	6.2263	2188.15	3216.7	18715.5	14986	18647.2	35823	68778	1228.45	1466.9
44	1	2	2	10	8.2382	2865.11	172.6	1518.2	4484	1723.9	6361	8281	351.79	787.1
45	1	2	2	11	2.8934	2798.77	149.3	2355.9	1635	136.5	987	598	177.22	291.1
46	1	2	3	2	5.4292	3888.36	7876.7	4365.8	21258	29898.8	36838	98744	455.36	33338.8
47	1	2	3	3	9.5953	1475.39	2845.9	14499.4	6511	5671.8	12748	22567	3411.35	25688.7
48	1	2	3	5	2.9245	1368.42	7142.3	4494.2	21913	5217.7	93347	26999	678.91	2355.7
49	1	2	3	6	1.3488	3772.65	334.7	2348.6	2456	283.6	1915	559	421.81	4487.8
50	1	2	3	7	1.7365	3781.11	849.8	1368.6	6835	3885.2	58877	25864	314.26	1195.5
51	1	2	3	8	3.2784	2527.37	642.9	3696.4	6498	1364.9	9874	8867	1581.27	46668.7
52	1	2	3	9	8.8281	2847.15	86.4	2619.2	2451	1732.5	4633	7646	391.55	219.7
53	1	2	3	10	1.2532	2754.89	941.5	2482.6	7334	2851.7	8164	11815	1812.96	688.8
54	1	2	3	11	7.3512	4581.48	5672.7	5941.8	7566	914.5	8638	6278	797.83	1842.4
55	2	1	1	2	6769.8	3959.14	369.5	3618.4	6315.1	8893.9	11682	24347	675.17	4731
56	2	1	1	3	6689.8	2728.35	1283.8	3738.7	5995.2	6237.3	7286	21163	735.93	73328

57	2	1	1	5	5776.4	4400.09	1090.8	1538.9	7981.4	2464.5	22227	10915	274.89	7227
58	2	1	1	6	8356.7	2476.73	272.8	23.4	1501.9	2856.2	999	6394	13.26	38
59	2	1	1	7	7444.5	1713.13	12090.8	1391.7	44255.6	24052.4	417764	138087	561.11	6777
60	2	1	1	8	8896.3	4190.00	1154.5	612.5	3090.6	2686.6	3879	7291	107.42	14379
61	2	1	1	9	10156.3	3527.94	265.1	12412.7	5454.1	3253.8	7511	10682	349.04	985
62	2	1	1	10	9669.2	2434.33	175.3	36.8	2410.8	5761.5	2652	8391	66.43	269
63	2	1	1	11	6225.6	3724.32	270.0	57.9	1158.8	730.1	1518	33431	62.40	444
64	2	1	2	2	9536.1	2832.73	970.4	2385.2	14965.1	8515.1	26768	28378	269.64	4112
65	2	1	2	3	10881.9	3459.78	633.6	725.5	7842.5	6710.9	13897	24288	114.09	115226
66	2	1	2	5	9454.3	2976.27	4628.2	2424.3	10491.8	7651.5	28485	54913	181.75	1825
67	2	1	2	6	12824.2	5306.71	48.5	3856.8	1185.3	1353.8	1312	13591	254.48	1526
68	2	1	2	7	7327.1	1684.58	2651.8	1676.6	6519.8	6586.8	16585	25763	218.53	5385
69	2	1	2	8	7922.4	3768.76	265.6	42.4	1411.8	4966.9	1720	14941	148.89	13284
70	2	1	2	9	8597.6	4637.92	813.5	33586.4	8711.7	6756.1	7867	22931	522.89	7857
71	2	1	2	10	8381.8	2411.83	230.8	49.7	4259.3	3918.2	3787	5389	114.34	278
72	2	1	2	11	9994.4	4230.13	194.6	2847.6	332.7	644.9	462	24633	193.86	315
73	2	1	3	2	8420.4	1542.54	1176.2	7688.8	20433.7	9837.1	24165	29688	507.18	18863
74	2	1	3	3	9855.1	2670.89	4589.5	2888.9	17461.2	5255.3	25536	17375	693.51	42162
75	2	1	3	5	12982.9	2110.39	3820.1	1834.1	12299.8	17511.6	35010	14583	466.14	836
76	2	1	3	6	7919.3	3347.83	2842.7	826.7	14877.1	3191.8	7308	8714	282.36	188
77	2	1	3	7	9343.8	2114.29	576.2	52.9	2282.6	10863.7	2327	31736	37.14	255
78	2	1	3	8	7893.2	3683.63	538.5	182.3	2969.7	1831.4	3232	3963	27.94	9721
79	2	1	3	9	11977.6	5986.84	78.6	13498.2	1262.7	7258.1	1176	19835	288.81	768
80	2	1	3	10	8176.5	2319.79	278.9	31.7	3447.8	4578.9	4717	6314	54.37	99
81	2	1	3	11	11861.3	5238.83	7342.3	31356.8	10891.8	16487.9	92639	66919	1395.58	125888
82	2	2	1	2	7655.9	121.30	2222.4	2199.7	66818.8	15816.4	162928	342815	298.88	13491
83	2	2	1	3	8963.8	2231.76	1884.6	616.6	6876.3	5854.5	18119	21728	682.88	19782
84	2	2	1	5	11465.1	2438.22	773.7	1916.5	4285.7	10838.5	5536	16164	297.86	1211
85	2	2	1	6	8696.6	2252.85	131.3	162.3	1898.1	3729.2	796	12296	21.99	468
86	2	2	1	7	9986.8	7357.84	7328.1	30368.5	7118.1	15999.8	13736	31894	1276.68	2229
87	2	2	1	8	6973.4	3917.68	347.2	148.8	1848.1	1344.2	2859	4266	25.75	7148
88	2	2	1	9	11355.4	3441.24	178.6	238.7	2788.3	5834.6	3285	12498	67.39	3543
89	2	2	1	10	9186.1	3191.43	976.2	298.8	4656.7	3918.7	6588	4336	113.18	265
90	2	2	1	11	9538.3	3913.59	1475.5	3575.7	4134.4	6184.4	7891	25269	563.91	3813
91	2	2	2	2	6695.9	375.62	439.9	1689.6	14572.8	2388.2	26761	8191	127.15	1228
92	2	2	2	3	7358.5	2465.32	1285.4	2388.8	4242.8	6663.8	7886	28833	295.58	36245
93	2	2	2	5	14775.4	2856.12	1247.5	938.8	7278.3	41862.8	15469	37528	186.85	2578
94	2	2	2	6	8784.5	2169.36	958.1	176.7	4161.8	3788.8	2325	12822	88.79	199
95	2	2	2	7	8388.8	2916.98	461.1	62.8	1856.8	4484.4	2617	19347	28.74	443
96	2	2	2	8	10476.8	3888.84	3169.4	2988.7	6728.2	3188.2	7898	9636	349.61	21221
97	2	2	2	9	10893.1	2888.23	2592.2	718.8	11875.3	18488.3	24797	53887	521.98	19357
98	2	2	2	10	8838.3	2677.14	371.6	139.5	2511.8	4498.2	2639	7216	188.66	393
99	2	2	2	11	13533.5	3868.79	739.7	284.9	2959.5	15232.8	7189	23361	91.28	726
188	2	2	3	2	7387.3	2733.18	889.4	1651.4	7168.3	8685.3	9377	23212	114.43	7224
181	2	2	3	3	9661.9	5245.18	2829.6	22847.5	6416.7	9491.7	8218	32418	1893.56	12871
182	2	2	3	5	8888.3	2866.55	3181.2	2868.8	17388.9	28861.3	43962	39286	67.45	6286
183	2	2	3	6	6875.9	3846.82	33.5	71.8	325.8	1194.9	242	5498	29.37	394
184	2	2	3	7	7976.6	3772.84	2159.5	1468.6	2562.5	3471.9	2159	33532	242.74	463
185	2	2	3	8	7697.1	1745.15	2889.9	1226.5	5741.9	3896.9	8582	12954	432.67	48764
186	2	2	3	9	10818.5	2286.38	258.9	283.9	3238.3	4998.8	6321	16141	396.52	56737
187	2	2	3	10	8812.4	2657.85	182.5	774.8	4158.1	2578.8	4271	5439	114.98	526
188	2	2	3	11	14715.8	3338.83	2445.3	24858.7	18238.7	26223.6	31615	38846	556.47	1595
189	3	1	1	2	858.96	184.99	136.5	537.8	3327.5	15931.6	6853	71916	39.72	16743
118	3	1	1	3	874.11	426.51	443.9	43452	16499.9	5584.5	14192	34428	448.83	6519
111	3	1	1	5	754.47	347.67	467.4	15341	5539.7	5334.1	5147	16888	497.68	1189
112	3	1	1	6	987.81	48.66	335.5	18234	6724.5	35527.4	6155	3418	583.35	2342
113	3	1	1	7	3.95	42.82	98387.3	2181	26579.6	19728.8	186856	184311	1864.47	27658
114	3	1	1	8	884.56	8.82	483.8	3327	6782.6	18896.2	9839	37692	323.83	4659
115	3	1	1	9	751.23	8.95	1886.4	182	6498.5	6441.8	9185	39673	69.88	1319
116	3	1	1	10	745.39	333.95	59.9	13249	4859.6	6894.5	4978	2686	248.88	197

117	3	1	1	11	809.33	15.49	823.3	12292	2616.2	4919.6	3427	15805	528.58	227
118	3	1	2	2	814.02	131.11	19977.8	54372	11499.9	15898.8	28216	67564	290.22	19718
119	3	1	2	3	717.26	627.87	1296.4	2858	7345.2	4474.9	14884	29637	777.29	19621
120	3	1	2	5	924.71	2.05	479.2	2598	8616.8	32488.3	14538	107265	584.36	1884
121	3	1	2	6	839.73	1.42	117.9	454	4835.9	13591.8	6452	3861	466.47	275
122	3	1	2	7	846.99	77.81	378.3	14993	3289.7	7887.3	8232	33576	888.38	4713
123	3	1	2	8	1877.73	361.88	21.8	8818	1463.8	12845.6	2648	45865	488.98	23134
124	3	1	2	9	876.74	3.54	143.6	72	1788.1	17429.8	3436	78673	35.71	13764
125	3	1	2	10	825.25	154.41	281.7	28112	9251.2	19219.4	14982	4275	545.85	443
126	3	1	2	11	957.88	3.34	329.6	623	2196.6	6582.1	2388	31945	166.88	479
127	3	1	3	2	562.89	1136.62	2317.5	83333	61528.9	36887.3	74549	[illegible]	2834.99	185395
128	3	1	3	3	916.37	587.11	1148.2	2622	13486.8	14299.1	17968	51264	1449.21	78291
129	3	1	3	5	627.81	248.93	752.4	552	4966.5	1177.6	14847	21713	21.18	679
130	3	1	3	6	698.58	386.73	625.8	16139	7814.8	11686.1	12765	4612	389.24	368
131	3	1	3	7	787.14	154.85	38.5	14788	4331.3	4443.8	9131	24483	448.82	931
132	3	1	3	8	719.39	172.68	838.3	18345	2543.4	2941.8	3874	12864	728.67	4936
133	3	1	3	9	661.74	9.61	112.5	38	1222.1	4567.6	1482	18649	47.66	18885
134	3	1	3	10	714.53	329.75	111.7	12843	2943.8	3936.8	6134	4222	229.48	241
135	3	1	3	11	989.67	5.34	392.9	5825	3111.8	33333.6	7824	182268	358.22	19676
136	3	2	1	2	9.78	1438.84	32892.8	169886	17339.2	25522.3	48695	183863	3248.71	77513
137	3	2	1	3	927.84	1839.98	325.8	32618	9662.1	41989.6	15429	156228	2225.93	21233
138	3	2	1	5	688.68	324.61	227.8	18259	2184.8	3177.8	6914	26444	998.89	591
139	3	2	1	6	758.81	276.28	211.8	6565	1195.7	9235.9	1154	1817	266.84	224
140	3	2	1	7	816.55	21.34	496.3	875	12426.7	11119.4	42811	64386	538.99	2781
141	3	2	1	8	662.48	38.54	158.2	8893	2886.5	1168.5	2327	7569	364.14	412
142	3	2	1	9	776.77	46.47	394.8	12342	2985.4	9266.4	5862	32887	624.51	4813
143	3	2	1	10	744.24	182.57	1267.6	14229	18464.5	5959.9	12918	6582	565.89	766
144	3	2	1	11	784.67	1.89	1439.7	258	4752.8	8647.2	48683	46192	174.53	6832
145	3	2	2	2	691.78	112.19	19816.3	29334	16587.6	25395.3	27264	78158	2133.45	76734
146	3	2	2	3	889.49	93.78	339.1	1885	1681.2	18613.8	7952	68686	23.81	18618
147	3	2	2	5	956.32	165.84	1133.9	16299	8864.4	75239.2	15816	35854	444.32	642
148	3	2	2	6	831.68	548.57	89.4	11133	381.8	3813.2	538	5348	789.77	357
149	3	2	2	7	663.45	16.57	239.5	18864	979.9	2675.8	1638	19318	337.38	953
150	3	2	2	8	625.76	136.95	168.9	23289	5578.6	1684.7	11824	18768	993.97	3282
151	3	2	2	9	694.47	62.21	1783.6	38813	15877.5	4597.1	34222	23421	682.68	844
152	3	2	2	10	782.61	486.95	377.6	18987	3237.4	3821.1	6519	7344	936.38	415
153	3	2	2	11	736.44	319.37	58.7	12851	3878.6	8484.7	3797	39877	669.41	673
154	3	2	3	2	728.18	29.58	7872.7	7436	3359.6	7865.1	18638	26297	22.25	28988
155	3	2	3	3	888.12	3.41	994.5	1285	8332.4	15198.9	9783	58883	458.56	3297
156	3	2	3	5	831.58	421.59	77.4	224	1862.9	6489.5	2897	32895	32.48	1855
157	3	2	3	6	759.55	9.82	135.7	11513	1792.6	11958.4	1349	2831	943.39	749
158	3	2	3	7	971.27	18.18	829.4	481	5249.1	24816.8	18533	87962	64.75	2939
159	3	2	3	8	736.85	338.53	2883.8	3968	5898.9	3991.8	8288	15264	449.32	3754
160	3	2	3	9	432.71	589.42	554.6	23113	9286.2	6711.6	15833	28886	1298.86	68898
161	3	2	3	10	781.73	228.16	563.7	23638	2473.5	5187.9	3685	6914	585.13	588
162	3	2	3	11	947.64	37.77	213.1	62	1351.5	15171.3	3465	56818	74.62	386
163	4	1	1	2	7.329	779.96	28575	118652	26712.9	48458.5	49298	129841	1753.71	39323
164	4	1	1	3	7.988	68.94	26491	18269	19588.7	7481.8	14746	33721	2854.15	36738
165	4	1	1	5	12.482	94.56	76368	14158	15813.5	18845.4	17283	49948	1874.87	3818
166	4	1	1	6	3.829	48.29	21281	11711	11769.8	1448.9	14955	6898	1229.16	12688
167	4	1	1	7	878.838	118.55	19244	46888	18475.9	26178.3	65679	278645	2135.13	46129
168	4	1	1	8	3.745	76.32	13792	5827	4126.8	8337.4	9321	35885	1883.91	46342
169	4	1	1	9	1.674	121.28	38361	22149	14142.8	6882.6	48294	23796	1289.15	1718
170	4	1	1	10	9.893	114.62	39829	19584	25858.5	16848.9	41492	27977	1558.16	2163
171	4	1	1	11	2.315	68.98	32182	18532	9549.5	2817.9	83581	82583	1889.84	23955
172	4	1	2	2	13.859	389.79	2366	38367	23168.4	27238.9	69838	94691	1859.29	45983
173	4	1	2	3	18.916	223.58	53883	3399	23185.4	15222.4	66271	73218	1315.33	52647
174	4	1	2	5	18.547	71.95	26233	6898	26565.7	16278.6	117787	84532	983.82	4861
175	4	1	2	6	4.586	27.77	14862	7139	22548.3	2179.8	22381	8316	1523.52	23224
176	4	1	2	7	28.439	165.91	12485	8119	21884.2	16371.8	42518	127654	884.97	19456

177	4	1	2	8	0.783	10.43	16882	3234	1695.2	5214.6	[illegible]			
178	4	1	2	9	4.260	48.39	22233	5331	5635.6	4971.8	25787	[illegible]	[illegible]	[illegible]
179	4	1	2	10	7.740	48.2e	25455	12687	28711.4	11898.8	74210	[illegible]	[illegible]	[illegible]
180	4	1	2	11	30.764	0.03	17170	2987	13987.0	7755.5	137750	[illegible]		
181	4	1	3	2	9.386	175.66	21551	106629	44160.5	50793.6	680271	[illegible]	[illegible]	
182	4	1	3	3	0.264	376.03	24019	20478	26364.8	12248.7	27790	48149	2456.86	52881
183	4	1	3	5	4.186	312.78	116396	21636	55891.2	11908.7	31387	47663	2629.6[illegible]	3030
184	4	1	3	6	4.501	27.21	36743	4378	15933.8	4883.8	12177	9624	1963.81	10749
185	4	1	3	7	7.946	130.19	17267	7739	24573.5	15554.6	144652	219032	1624.7[illegible]	9941
186	4	1	3	8	2.694	66.07	53851	5273	14742.7	4948.5	52311	29925	1097.1[illegible]	62634
187	4	1	3	9	0.000	143.35	19760	17283	3521.5	2317.5	27614	8747	660.80	770
188	4	1	3	10	1.375	79.43	26146	14594	31305.9	5792.1	29669	12099	1149.94	1367
189	4	1	3	11	21.771	93.22	13598	3919	7667.2	17502.5	72382	88618	843.95	127918
190	4	2	1	2	9.780	1438.84	32892	169886	17339.2	25522.3	48695	183863	3240.71	77513
191	4	2	1	3	14.644	112.53	21202	26526	12665.3	18496.5	34225	73407	4392.37	60845
192	4	2	1	5	56.758	1345.18	68713	46593	25617.1	18384.2	149165	150911	1143.93	13891
193	4	2	1	6	2.827	8.26	34548	3669	29278.3	3688.5	23860	11021	1480.77	19312
194	4	2	1	7	13.712	46.78	49119	3274	24128.6	23814.8	73146	122878	1032.69	33939
195	4	2	1	8	13.232	52.56	34619	10643	15646.5	9384.5	21574	35617	1083.94	89983
196	4	2	1	9	9.251	788.41	17427	51274	19571.8	21332.9	29651	61789	824.33	48177
197	4	2	1	10	1.745	49.62	19021	2523	5311.9	15474.8	16218	58557	583.42	8458
198	4	2	1	11	14.239	34.43	16185	6656	5661.5	16717.8	102498	121479	1589.55	48205
199	4	2	2	2	2.089	18.16	232	4971	5998.8	17251.7	10795	35041	198.35	68279
200	4	2	2	3	3.206	160.97	26135	23747	7876.3	7584.9	32294	34582	1320.61	26405
201	4	2	2	5	34.495	1160.79	34060	39635	12320.7	4190.2	45093	32034	2160.21	7226
202	4	2	2	6	0.782	12.62	47718	2389	16871.5	1313.3	7185	3866	652.84	4403
203	4	2	2	7	0.976	26.11	24583	3351	12370.4	3586.6	29664	33864	763.20	7775
204	4	2	2	8	7.035	49.81	52855	13246	17022.0	7002.7	36973	34132	1384.64	92859
205	4	2	2	9	0.967	23.59	40597	4428	18045.9	4819.5	49770	13418	1056.92	4763
206	4	2	2	10	3.983	41.49	49608	5704	19272.2	11378.0	33474	35610	935.73	1678
207	4	2	2	11	13.487	74.58	35985	9059	15984.2	15579.4	83770	79106	804.81	12035
208	4	2	3	2	4.510	259.55	1843	33981	18469.2	21535.1	25140	74946	618.27	25415
209	4	2	3	3	7.563	18.45	44983	10232	14739.0	14872.2	36317	67591	2111.96	62078
210	4	2	3	5	35.393	664.26	19290	55896	51606.0	11679.0	133512	179769	1011.27	12541
211	4	2	3	6	2.261	31.24	43559	2553	9759.1	262.1	4482	953	597.20	8793
212	4	2	3	7	20.004	38.08	25133	4000	5198.1	14214.3	19271	110273	560.40	21546
213	4	2	3	8	4.891	57.58	38267	23955	6085.0	5503.0	36440	28964	4364.18	173975
214	4	2	3	9	3.453	12.56	15959	2734	3665.9	7498.3	24047	21725	527.32	2193
215	4	2	3	10	0.484	6.74	38414	3226	12417.6	2580.2	14401	18323	1702.29	1567
216	4	2	3	11	27.575	135.94	55983	32091	17514.2	16328.2	65048	104663	2047.76	43174
217	5	1	1	2	630.02	365.60	1323.8	18280	25710.4	42867.3	49515	139895	1106.93	36304
218	5	1	1	3	749.27	234.61	21745.2	69190	11724.5	11909.3	45652	53818	3231.15	48085
219	5	1	1	5	1122.42	42.17	1385.5	2871	7980.0	34485.1	17658	62141	501.67	61491
220	5	1	1	6	866.96	2.17	188.2	1005	3217.3	21882.7	6794	16124	393.25	437
221	5	1	1	7	6.75	2599.49	2518.3	16539	8431.6	7915.8	14008	53811	688.13	2569
222	5	1	1	8	707.91	1238.26	13420.4	21516	7600.7	6245.1	22746	31312	1818.40	48917
223	5	1	1	9	620.74	68.07	1864.1	35158	18255.3	15079.8	20802	48182	1176.57	1998
224	5	1	1	10	800.58	161.15	589.4	20566	11440.9	26624.5	22652	40430	641.15	1277
225	5	1	1	11	963.89	291.51	1052.5	24368	9064.0	40181.1	82428	147030	4871.49	140745
226	5	1	2	2	804.16	1387.96	20281.9	10717	27079.9	15118.7	81079	53742	745.13	41852
227	5	1	2	3	830.05	58.51	158.5	20252	7838.4	15632.8	11770	53486	1871.68	45055
228	5	1	2	5	680.32	7.28	314.8	1285	8193.5	3275.5	31122	24805	237.66	5855
229	5	1	2	6	1021.18	11.78	904.8	3898	9727.0	44167.9	10482	60754	462.68	18758
230	5	1	2	7	720.29	10.72	2770.8	6849	16496.2	3912.0	31139	36685	1220.39	5048
231	5	1	2	8	534.59	141.13	4288.8	50937	11837.2	13698.8	79081	45119	1044.06	31002
232	5	1	2	9	680.29	23.52	7171.3	7077	14265.5	7866.9	37123	30265	339.74	110497
233	5	1	2	10	959.17	17.32	416.0	6984	6501.5	44190.6	11461	54032	263.36	1066
234	5	1	2	11	1089.99	1.06	425.7	665	7987.3	65784.2	61669	187898	233.88	23429
235	5	1	3	2	858.30	386.96	27979.3	62581	45211.0	84227.0	366628	555456	602.28	34661
236	5	1	3	3	558.56	16.21	15170.7	18340	14226.1	9915.8	35840	51092	2333.13	132058

237	5	1	3	5	852.16	242.62	16451.9	43671	23581.2	61131.7	61972	58364	2897.62	5854
238	5	1	3	6	848.52	4.97	217.3	658	4612.6	30664.3	3696	13226	169.74	152
239	5	1	3	7	848.38	7.06	1837.4	2179	4188.2	11260.9	18459	91581	539.99	9450
240	5	1	3	8	508.62	69.37	5288.2	13095	3098.5	13191.6	9400	49997	1874.75	139995
241	5	1	3	9	903.58	47.01	326.9	5249	5249.7	11525.5	8596	34381	514.22	34026
242	5	1	3	10	760.64	25.74	3785.8	8434	16971.0	22645.0	21127	17001	114.93	417
243	5	1	3	11	1008.76	91.99	1721.7	3296	23655.9	43770.1	59462	225346	466.80	79146
244	5	2	1	2	560.28	617.21	80418.7	58118	35382.2	34522.2	87463	134153	1087.83	66321
245	5	2	1	3	679.42	119.63	32416.9	6329	20336.5	29498.9	60376	121171	1072.58	389324
246	5	2	1	5	799.27	4187.79	54134.3	134499	29637.2	21012.9	161355	119513	1354.13	40633
247	5	2	1	6	809.67	19.87	63.8	4159	1382.0	10031.0	1333	10827	1089.06	615
248	5	2	1	7	894.80	287.93	3674.8	34279	17330.2	12179.7	171181	166606	880.11	15776
249	5	2	1	8	813.66	262.66	13922.0	71528	7836.0	3250.7	9749	18195	772.84	73564
250	5	2	1	9	563.95	2629.65	10086.2	20470	5104.4	21742.1	15052	69876	515.34	25002
251	5	2	1	10	853.12	122.27	516.3	27619	7004.2	10151.2	14941	41061	2242.28	2863
252	5	2	1	11	1486.13	48.42	3922.1	2042	5419.2	35732.6	69146	236350	960.39	64951
253	5	2	2	2	642.84	5351.67	81846.1	333367	61191.5	9168.6	211520	44315	6290.49	31477
254	5	2	2	3	758.98	423.31	20226.5	49424	50865.8	26225.3	663032	152956	2302.58	376386
255	5	2	2	5	1296.63	41.56	1218.4	1909	1988.5	5560.0	5732	74610	280.55	8202
256	5	2	2	6	893.36	0.46	88.1	186	2518.5	40737.0	4788	40036	46.16	409
257	5	2	2	7	827.51	14.35	2619.0	2378	4213.3	15207.3	7608	101599	704.82	4329
258	5	2	2	8	723.42	132.61	5528.8	10740	6777.9	19192.7	12686	71591	586.77	30743
259	5	2	2	9	456.64	208.19	5181.2	17965	6841.6	11206.8	31589	54748	374.75	250626
260	5	2	2	10	1043.87	86.09	232.3	15663	5476.5	55483.0	10010	64863	902.08	1310
261	5	2	2	11	858.83	111.21	893.8	97864	4959.1	15663.1	9875	65282	1463.58	32863
262	5	2	3	2	856.49	583.41	4748.2	6959	15591.7	20357.2	33274	59627	878.87	119171
263	5	2	3	3	952.85	252.58	31973.1	36757	13123.6	19273.0	58581	92427	1638.09	431138
264	5	2	3	5	814.32	81.19	524.9	477	9488.8	8622.4	68780	49197	588.06	7559
265	5	2	3	6	802.81	3.34	151.2	508	2953.1	22402.9	1246	15128	50.70	580
266	5	2	3	7	1143.35	38.59	4467.2	5287	7302.5	59008.4	19492	458491	528.71	3310
267	5	2	3	8	699.77	35.47	2816.6	7050	3616.6	11666.4	7341	45083	464.68	120245
268	5	2	3	9	613.25	79.40	371.3	10349	10034.3	17247.5	16677	67066	1253.78	37453
269	5	2	3	10	996.66	75.32	412.9	758	4057.1	38943.7	3730	55406	697.33	1083
270	5	2	3	11	820.10	22.85	7643.3	5494	23529.0	17509.2	40663	197706	716.67	75468
271	6	1	1	2	16.54	1895.1	25328.5	36975	32831.0	.	68689	164935	1471.73	97355
272	6	1	1	3	3.23	5926.3	2274.1	1849	8030.2	.	6196	12534	180.67	6407
273	6	1	1	5	2.32	2717.3	46047.3	8178	7662.8	.	16481	36629	2430.28	3978
274	6	1	1	6	3.90	12240.2	57074.9	9738	12355.3	.	4388	4296	1003.52	12105
275	6	1	1	7	2949.76	1262.2	8864.7	8175	10381.2	.	41884	188399	446.35	3997
276	6	1	1	8	7.20	3558.2	9490.5	47678	26951.1	.	17082	30563	1681.70	16121
277	6	1	1	9	40.42	3493.1	31843.9	31565	8241.1	.	28358	11696	922.50	33958
278	6	1	1	10	21.61	1396.9	36327.7	12339	25296.2	.	25198	69747	2619.27	4443
279	6	1	1	11	22.86	1308.2	20296.9	71927	28934.9	.	83774	62970	5351.92	103300
280	6	1	2	2	93.27	11552.6	1347.1	42843	32473.3	.	36808	81360	1009.05	17492
281	6	1	2	3	13.20	5043.8	22633.7	43560	36872.9	.	41396	60308	1551.10	35536
282	6	1	2	5	27.00	5428.2	35177.0	18171	5646.7	.	7716	68338	1064.29	2225
283	6	1	2	6	1.31	968.6	61786.2	17214	55783.4	.	32891	7733	3122.04	8753
284	6	1	2	7	16.46	5028.8	1310.8	6394	18478.1	.	45784	82889	1727.80	21924
285	6	1	2	8	1.29	2276.1	1053.4	1521	15858.6	.	10244	8115	181.94	5649
286	6	1	2	9	57.97	1621.7	17961.1	36248	35377.6	.	50477	11538	674.41	25194
287	6	1	2	10	3.74	1648.1	36729.1	14194	28828.9	.	25668	76485	1953.07	1881
288	6	1	2	11	30.05	4369.9	51011.1	12248	9232.1	.	69993	98767	1019.85	57814
289	6	1	3	2	44.08	1347.9	6904.8	339974	25395.1	.	135100	317392	3759.96	27253
290	6	1	3	3	74.95	3412.3	1186.6	19130	15239.2	.	30853	62619	1045.72	46121
291	6	1	3	5	3.60	2966.7	9496.5	2622	6127.7	.	73222	23455	235.07	6327
292	6	1	3	6	2.36	3971.6	56610.0	25237	31666.4	.	7709	3296	1544.73	27295
293	6	1	3	7	2.52	2901.6	62248.8	25657	9580.2	.	28764	80279	1377.42	12687
294	6	1	3	8	10.91	2031.5	11347.5	34565	21192.3	.	18967	27433	3025.93	30244
295	6	1	3	9	8.73	1962.5	16270.6	2799	25775.1	.	16556	4226	102.30	1010
296	6	1	3	10	3.54	2155.6	34317.6	31733	18795.9	.	53976	52313	1258.09	3469

297	6	1	3	11	47.40	2335.4	50850.9	17946	39369.5	.	85779	76151	1612.43	59417
298	6	2	1	2	12.40	1634.6	7846.2	33149	20992.4	.	36933	171649	371.90	37183
299	6	2	1	3	17.46	15428.5	3750.3	175783	26835.4	.	42302	58130	3554.59	29541
300	6	2	1	5	1.62	1580.2	363.7	105	1663.4	.	1835	16117	59.55	8999
301	6	2	1	6	2.02	5394.8	53275.1	44736	59118.0	.	16900	10333	2765.86	10105
302	6	2	1	7	1.01	2689.8	15565.3	9062	5725.3	.	39919	33891	1062.61	2906
303	6	2	1	8	0.65	1565.2	2286.1	8749	7619.7	.	14788	14618	1361.99	16761
304	6	2	1	9	3.26	25.1	126.0	151	1963.9	.	7117	115956	268.24	3895
305	6	2	1	10	20.81	423.0	44075.2	45250	23544.3	.	48171	90561	1035.25	36094
306	6	2	1	11	23.93	465.9	16729.1	4244	4414.8	.	9683	22033	1469.80	8541
307	6	2	2	2	8.82	3252.8	1838.7	61818	14844.6	.	20967	68585	683.05	2958
308	6	2	2	3	8.12	915.9	1448.7	5734	22725.5	.	24132	76939	463.31	5083
309	6	2	2	5	7.62	7285.2	24018.7	56519	15378 5	.	51776	13628	1463.48	12306
310	6	2	2	6	6.54	2316.6	60418.7	20287	14286.9	.	10908	6841	909.51	17979
311	6	2	2	7	1.37	1527.6	21486.7	4881	8917.2	.	19824	136368	840.51	17523
312	6	2	2	8	10.13	1146.5	16151.8	42620	28821.8	.	49488	30668	4310.87	78009
313	6	2	2	9	52.00	3110.3	39877.3	103071	36823.3	.	55613	40532	3621.23	51597
314	6	2	2	10	26.57	1898.8	21497.8	12208	11422.8	.	16430	91612	1485.60	11429
315	6	2	2	11	12.44	4793.5	1709.8	232684	8329.1	.	38978	194152	4465.26	30924
316	6	2	3	2	4.18	4001.9	57351.5	148004	21565.8	.	61075	66184	3623.54	48897
317	6	2	3	3	3.89	8049.4	2277.0	22427	21190.1	.	34303	44618	1285.74	25221
318	6	2	3	5	15.96	2957.9	741.6	498	5522.1	.	5443	3411	77.75	12973
319	6	2	3	6	2.86	22966.6	56609.8	9588	5999.1	.	1460	1550	330.56	11072
320	6	2	3	7	6.80	5715.1	30792.9	78024	9938.7	.	95015	109677	7034.40	14520
321	6	2	3	8	19.29	3311.8	29851.3	33461	24718.2	.	22200	27897	3049.53	117392
322	6	2	3	9	3.7	465.9	22769.7	28583	43638.3	.	18559	17903	480.23	955
323	6	2	3	10	55.1	4292.9	9127.2	4650	11102.4	.	82095	314444	565.38	122456
324	6	2	3	11	37.67	1773.4	3504.6	52473	11866.8	.	48712	69120	1778.64	48658
325	7	1	1	2	3880.4	4441.98	2682.0	3720	15303.8	26045	13594	76779	65.1	44425
326	7	1	1	3	2123.8	1716.62	2668.5	23448	8303.6	8603	10944	28794	1311.2	3015
327	7	1	1	5	2964.4	1066.89	1415.3	1187	12666.0	11217	22978	18209	792.2	2990
328	7	1	1	6	2652.1	39.87	75.1	9637	2663.4	1222	1584	2896	569.9	27572
329	7	1	1	7	18231.3	846.33	5494.6	140055	19390.3	29324	132485	173882	3189.1	19151
330	7	1	1	8	2719.6	2007.10	3009.6	2459	3714.0	6224	6133	21116	578.5	16516
331	7	1	1	9	2924.7	2111.64	1600.1	1681	6264.0	12173	6172	31733	306.9	1901
332	7	1	1	10	2698.1	3656.00	635.7	909	4538.9	8514	5717	6000	70.7	459
333	7	1	1	11	2077.4	830.62	7216.7	47416	5945.2	14536	28877	104589	4627.9	7502
334	7	1	2	2	2233.7	761.82	1973.6	74248	25729.9	13520	74405	52719	1438.1	19916
335	7	1	2	3	3537.3	3437.00	442.9	10055	7300.2	4277	11501	14254	592.8	15286
336	7	1	2	5	2553.0	5348.89	1312.2	47	2767.1	2642	5657	6379	34.6	2042
337	7	1	2	6	2853.2	1888.58	325.3	134	5327.5	8252	3104	23453	230.8	510
338	7	1	2	7	1292.0	3959.30	15162.0	72475	11528.5	16936	51933	60852	1562.5	29299
339	7	1	2	8	2214.7	6018.56	4456.5	216	6229.7	11562	10955	38006	108.3	58676
340	7	1	2	9	3097.4	1477.70	270.8	465	3044.3	14822	10305	44389	402.7	38642
341	7	1	2	10	4568.5	5078.29	264.5	15319	6906.0	146768	12147	29206	1182.9	982
342	7	1	2	11	4360.8	1758.01	1044.2	4699	8706.7	23818	53800	64157	398.2	122382
343	7	1	3	2	3678.9	7883.41	7454.3	282849	59634.6	98945	172408	310157	5725.2	153006
344	7	1	3	3	2497.9	3645.30	626.3	28002	4639.0	3442	5595	12603	396.6	1161
345	7	1	3	5	2788.3	3193.20	3300.1	545	27476.8	11187	27365	41170	158.2	3101
346	7	1	3	6	2657.3	2094.07	201.6	279	2434.6	3909	1869	13735	59.6	48
347	7	1	3	7	3336.9	1451.94	2204.4	1054	6105.6	21494	23234	25360	110.9	1627
348	7	1	3	8	3047.4	2099.87	2113.0	10557	5329.7	4232	11273	11774	743.6	46882
349	7	1	3	9	2675.9	1387.11	241.4	286	2859.5	6848	5265	14420	198.9	987
350	7	1	3	10	2761.0	1979.94	932.0	103	9562.3	4584	8906	4769	89.8	641
351	7	1	3	11	2599.5	1448.40	4861.1	705	9165.8	30063	28941	82949	176.7	42681
352	7	2	1	2	3119.3	4151.32	4274.2	211693	19677.9	31952	37017	114791	3588.1	91566
353	7	2	1	3	4103.8	3162.63	826.8	157001	17869.7	23250	35162	98950	2598.1	122574
354	7	2	1	5	2679.1	3976.26	16647.7	3665	11821.9	15814	17982	34254	294.4	5289
355	7	2	1	6	2846.6	1920.84	2836.6	998	6945.9	13243	1651	11362	193.1	368
356	7	2	1	7	3260.6	1570.72	1583.0	2661	7189.0	28053	82500	63843	287.6	5266

357	7	2	1	8	2389.0	3793.71	219.7	10443	2122.7	8554	3529	21442	494.7	11943
358	7	2	1	9	2709.3	2852.54	388.0	1225	1706.5	3351	3075	12182	178.2	1102
359	7	2	1	10	2810.2	2551.96	875.5	19721	4231.2	15246	12159	12874	823.3	15300
360	7	2	1	11	2285.8	1812.32	4271.8	2833	3863.8	21120	24161	37048	398.8	1598
361	7	2	2	2	154.0	3172.82	2562.4	5047	10834.8	10007	17143	30996	51907.9	469
362	7	2	2	3	2420.7	2783.19	507.3	6998	4187.6	11704	10989	44953	363.8	21677
363	7	2	2	5	2981.5	8477.86	4209.0	26963	5896.1	36750	6456	45846	483.6	2708
364	7	2	2	6	2661.5	2388.98	142.9	89	1933.5	7854	1870	22524	7.3	236
365	7	2	2	7	3856.3	2713.22	1734.0	3834	11893.3	38974	51805	42283	362.5	4666
366	7	2	2	8	2825.9	3630.98	3859.5	2336	13462.0	6238	13725	10027	98.9	85221
367	7	2	2	9	2939.7	163.36	565.8	2008	6473.1	19171	13003	59481	866.3	4324
368	7	2	2	10	2752.2	2823.83	406.8	129	5135.0	3633	8625	10939	22.1	306
369	7	2	2	11	2770.6	973.78	5763.7	1211	5765.2	28439	43211	28792	184.9	2558
370	7	2	3	2	2150.6	5016.15	328.5	19713	4460.4	8723	6900	29686	209.7	19852
371	7	2	3	3	2593.8	1766.69	517.1	11411	6631.3	4460	7765	14017	447.8	2186
372	7	2	3	5	3863.9	2712.27	1576.8	30	4849.9	2611	4279	5416	28.6	384
373	7	2	3	6	2145.2	1004.50	679.8	10104	6320.2	13874	5279	24718	163.1	501
374	7	2	3	7	2866.3	2302.77	4901.3	4993	6341.0	4181	15354	49946	227.2	863
375	7	2	3	8	2443.3	3522.91	609.0	3649	4308.1	23169	10821	74483	1179.1	144187
376	7	2	3	9	2324.2	2844.19	226.5	3903	3251.2	15374	5606	41610	501.4	2930
377	7	2	3	10	3144.4	1784.59	17923.7	6815	35212.2	16946	32677	25123	1661.4	1373
378	7	2	3	11	3189.5	2976.69	2196.9	3837	4006.8	1048	7193	60442	163.1	997

P = FLIGHT PHASES 1 THROUGH 7
G = 1. FLIGHTS WITHOUT CB GLOVE 2. FLIGHTS WITH CB GLOVE
CAA = 1. BOTH ARMREST AND CONTROLLER WERE FIXED 2. THE CONTROLLER WAS ADJUSTABLE 3. BOTH ARMREST AND CONTROLLER WERE ADJUSTABLE
SUBJ = SUBJECTS
HD = HEADING
ALT = ALTITUDE
AS = AIRSPEED
ROC = RATE-OF-CLIMB
CYC = CYCLIC; CYC-PIT= CONTROL MOTION FORE-AND-AFT; CYC-ROLL= CONTROL MOTION SIDE-TO-SIDE