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ABSTRACTS OF AERODYNAMICS DEPARTMENT COMPUTER PROGRAMS,(U)

AUG 74 R D ELLIOTT

UNCLASSIFIED LR-26575 NL

1 OF 1

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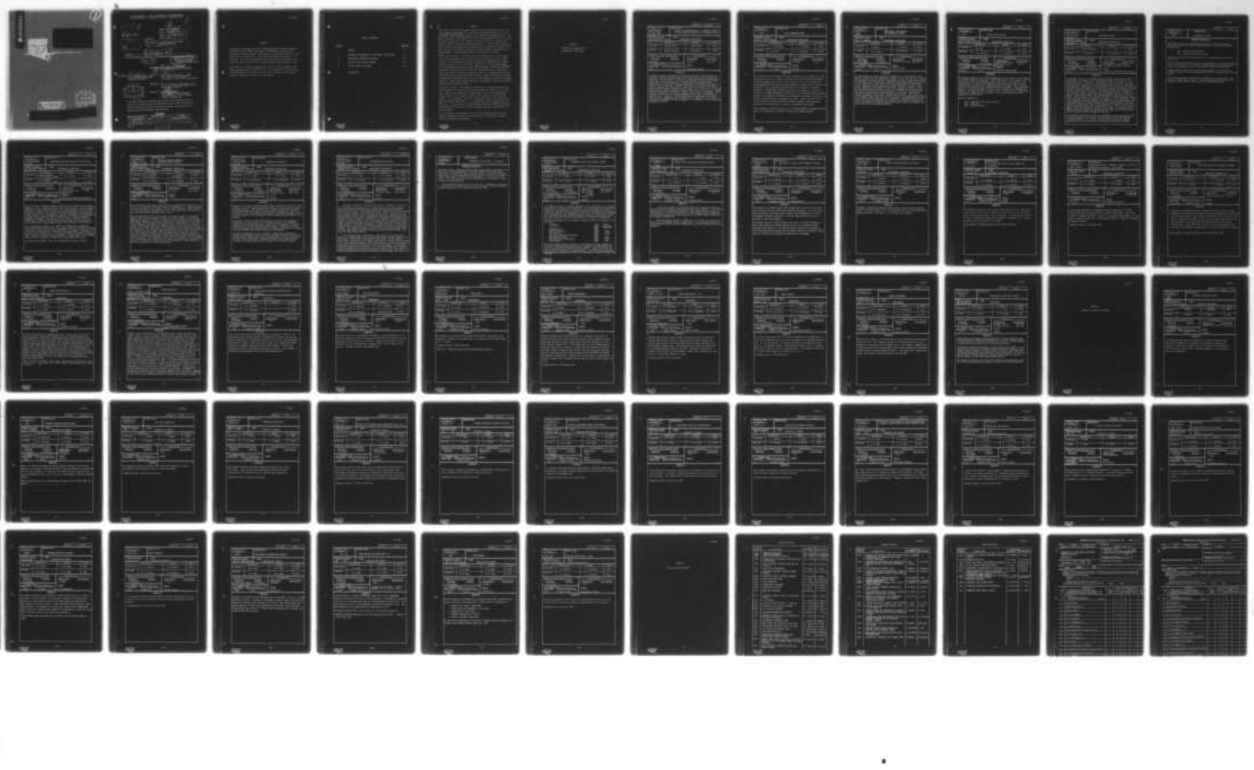

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Division of Lockheed Aircraft Corporation

BURBANK, CALIFORNIA, U.S.A.

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# ABSTRACTS OF AERODYNAMICS DEPARTMENT COMPUTER PROGRAMS

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**REVISIONS**

| REV. NO. | DATE | REV. BY | PAGES AFFECTED | REMARKS |
|---|---|---|---|---|
| 1 | 12/22/75 | RDE | All | complete revision |
| 2 | 11/76 | RDE | All | |

FORM 402-2

209 970

# FOREWORD

This report was prepared under the Lockheed-California Company Independent Development task entitled "Development of Aerodynamic Design Computer Programs for Advanced Subsonic and Supersonic Aircraft Applications," funded under 1974 W.O. 41-5671-4534. Revision 2 was funded under 1976 W.O. 41-5686-5332. The report originated within the Aerodynamics Department (75-41), Flight Sciences Division (75-40), Advanced Design and Technologies (75-01).

This report is intended to supersede Section 2.10 of the Aerodynamic Data Manual, LR 18275 (last revised 4-30-68). It is expected to be revised more frequently than was LR 18275 and, because of its smaller size and single purpose, distribution is expected to be improved.

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| | DISTRIBUTION | |

# SUMMARY

This report consists of one-page abstracts of active batch processor or computer graphics programs, in use by the Calac Aerodynamics Department (75-41). In general, remote terminal programs (Conversational Programming System - CPS) are not included. The exceptions are when a CPS program has received relatively general usage and is not frequently modified, or when it represents the dominant means of computing particular quantities. Several batch programs are also available under DCAS (Direct Computer Access System) which permits input data edit and job submittal from remote locations without the intervention of the programer. Those programs available under DCAS are so noted.

This report's purpose is to inform users and potential users of the availability of the programs, their computing costs, the status of their documentation, and the responsible parties to contact in Aerodynamics and Computer Services, as well as to provide brief descriptions of the programs. The active programs divide logically into three categories: those which generate aerodynamic coefficients such as lift and drag coefficients, usually from inputs consisting of geometry descriptions, Section 1; programs which compute performance such as range and takeoff distance, usually from input consisting of aerodynamic coefficient data, Section 2; and stability and control programs, Section 3. Within each category abstracts are arranged in order of increasing Computer Services program number.

In addition, Section 4, containing a partial list of inactive programs, has been included as a check list for anyone contemplating creation of a new program. There is the possibility, though remote, that previous programming exists which would be cheaper to resurrect and modify than starting from scratch. As a precaution, it should be noted that many of the inactive programs are beyond reactivation, i.e., documentation and/or program decks have been lost. A file cabinet in the Aerodynamics Department (#804936) contains documentation for most of the inactive programs for which documentation originally existed.

It is intended that this report be kept current through periodic revision. Suggested changes or additions to the abstracts or errors found in them should be channeled to the author.

# SECTION 1

## PROGRAMS FOR GENERATION OF AERODYNAMIC COEFFICIENTS

REVISED 12-22-75

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 2095 or P2095 in DCAS, MØC | METHOD OF CHARACTERISTICS - A COMPUTER PROGRAM FOR THE DESIGN AND ANALYSIS OF HYPERSONIC INLETS |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM 360 Batch or DCAS | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Marida Slobko | Bert Bivens | 7-5915 |
| ENGINEER | Sherwin Maslowe | Don Krivec | 7-2078 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 2-4/Case | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 265 K | 2 |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| LR 18130 | Aug. 1964 |

STATUS

Reasonably Current

ABSTRACT

A computer program, developed for determining the flow field properties in and about supersonic and hypersonic inlets incorporates various analytical techniques for the solution of both the inviscid and viscous flow phenomena which occur in such inlets. The techniques employed are applicable to two-dimensional and axially-symmetric configurations operating in either a perfect gas or a real gas in chemical equilibrium. The method of characteristics is utilized for the solution of the supersonic inviscid flow field which includes multiple families of shock waves. The viscous flow is computed starting with a laminar boundary solution developed for a real gas by N. Cohen. Following transition, a turbulent boundary layer solution is employed. This analysis is based upon an integral parameter method with a correlation for skin friction. Included in the program logic are relationships for shock boundary layer interaction and the prediction of separation. While this is a Propulsion Department developed program, it is available to the Aerodynamics Department via DCAS.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 2588 | CALAC ATMOSPHERE MODEL |
| COMPUTING SYSTEM | TYPE |
| IBM 360 BATCH FORTRAN | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | J. F. Holliday | R. E. Posthumus | 7-2059 |
| ENGINEER | L. J. Aker | R. D. Elliott | 7-2852 |

| COMPUTING COSTS--MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| 0.1 MU/ATMOS | - |

| PROGRAM SIZE | |
|---|---|
| BYTES CORE | BOXES OF SOURCE CARDS |
| 1.4 K | 1/2 |

| DOCUMENTATION | |
|---|---|
| USERS MANUAL | LAST REVISED |
| LR 19809 | 9-1-67 |

STATUS

Current

ABSTRACT

A Lockheed-California Company developed standard and non-standard day atmosphere model exists as a general subroutine in several airplane performance computer programs and has been used to generate a series of standard and non-standard day tables which present atmospheric properties as a function of altitude. The non-standard day definition is with respect to pressure altitude. Standard day atmosphere properties are identical to those presented in the NASA-USAF-Weather Bureau 1962 U. S. Standard Atmosphere report. Entry to the general subroutine and table generator programs is possible with either pressure altitude or geometric altitude. Shorter versions of the routine exist in several CPS remote terminal programs. Table generator results are also published in LR 18725 - Aerodynamic Data Manual.

This program is currently inactive as a separate program in Computer Services but, as a subroutine, it exists in several performance programs.

LR 26575

| | REVISED 12/22/75 |
|---|---|
| PROGRAM NUMBER OR ACRONYM<br>4005<br>ADAIS | PROGRAM NAME<br>AERODYNAMIC DATA ANALYSIS AND INTEGRATION SYSTEM |
| COMPUTING SYSTEM<br>IBM 360 GRAPHICS | TYPE<br>AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | P. Grant | W. M. Baker | 7-3537 |
| ENGINEER | M. I. Grove | N. M. Werner | 7-1274 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 14 MU/HR SCOPE TIME | .04 MU/PLOT | LR 27274 124 pages | Aug. 1975 |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | Nearly current | |
| 126 K | 6 | | |


ABSTRACT

The ADAIS graphics program provides the capability for working with large amounts of data such that addressable elements of the data base can be called up for graphic display, compared, manipulated, stored, retrieved, and output for hardcopy plots. The principle application has been storage and retrieval of six component force and moment data from large numbers of wind tunnel tests. Data points from a specific run from a specific test can be called up and displayed on the screen, automatically or manually scaled, a curve faired through the data points by any of four methods, points deleted from the fairing, and deleted points reinstated. In addition, data from other runs may be called up and displayed along with the first. Differences between designated curves can be computed and displayed. Cross plots such as incremental drag coefficient due to spoilers at a constant angle of attack versus spoiler deflection angle can be generated. Hardcopy plots obtained from 35 millimeter microfilm can be obtained for all graphic displays, complete with sufficient background grid and accented lines to be suitable for direct inclusion in engineering reports.

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4403 | SONIC BOOM SIGNATURE |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 BATCH FORTRAN | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | LEN GRAY | T. J. JONES | 7-2564 |
| ENGINEER | R. D. ELLIOTT | R. D. ELLIOTT | 7-2852 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.15 MU/CASE | 0.01 MU/PLOT |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 276 K | 1.5 |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| NASA CR-1299 + NASA TND-3082 + Calac Mod Sheets | 1/21/74 |

**STATUS**

UNIFIED WRITEUP NEEDED

## ABSTRACT

The program treats the near field propagation of sonic boom in a horizontally stratified atmosphere with winds. Complex maneuvers of the aircraft, including climbs, dives, accelerations, turns, rolls, etc. can be treated. The propagation of the shock wave disturbance is traced all the way to ground level and may be examined at distances laterally displaced from the ground track of the aircraft at any elevation below the aircraft. Calac Mod sheets describe in detail the input for level flight, constant Mach, standard day flight -- the case type most frequently run for obtaining boom overpressures and pressure signatures at the ground. A plot option gives shock wave signature at ground level.

Related programs are:

- 4625 - Supersonic Wing Camber Analysis
- 4404 - Wave Drag
- 2955 - Mission Analysis

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4404 or P4404 in DCAS | AIRPLANE WAVE DRAG |
| COMPUTING SYSTEM<br>IBM 360 BATCH FORTRAN AND DCAS | TYPE<br>AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Norma Brunkhardt | T. J. Jones | 7-2564 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 7-2852 |

**COMPUTING COSTS---MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 4-6.5 MU/CASE | 0.3 MU/PLOT |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 226 K | 2 |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| 13 page NASA I.P.Description + 44 pages Calac Mods | 9-19-75 |

STATUS

Current but unified report needed.

ABSTRACT

Aerodynamic wave drag is calculated using the theory that the wave drag of an aircraft is the same as that computed by slender body theory for an equivalent body of revolution. An equivalent body of revolution is determined by passing a series of cutting planes through the three-dimensional configuration. Cutting planes are inclined at the Mach angle. The forward projected areas intercepted by cutting planes located at intervals along the aircraft longitudinal axis define the cross-sectional area distribution of the equivalent body of revolution. The cutting planes can be oriented at various angles, theta, around the aircraft longitudinal axis resulting in a family of equivalent bodies, each corresponding to a particular value of theta. The wave drag of the aircraft is taken to be the integrated average of the equivalent body wave drags of each member of the theta family. Additional features include an automatic fuselage area ruling option which permits determination of optimum fuselage area distribution within specified constraints, wave drag of each of the components in isolation, and optional plots of equivalent body area distribution for up to five selected theta angles, plots of drag/dynamic pressure versus theta, and average equivalent body, and fuselage normal cross-sectional area plots, both of which show results before and after fuselage area ruling.

The program is particularly suited to treatment of configurations have non-circular fuselage cross sections, fuselage engine inlets, and cambered fuselages and wings, all of which can be described in detail although computing costs are increased as the description becomes more complex.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4404 | AIRPLANE WAVE DRAG |

ABSTRACT (continued)

Card Decks in the wave drag format have become the standard method of describing geometry to several related programs of which those available at Calac are:

4406 - Wetted Area Calculation

4407 - Airplane Configuration Plot

Presently the Wetted Area program (4407) is run automatically each time 4404 is run.

After digitizing the geometry of any new configuration, but before submitting for a wave drag run, it is strongly recommended that the Airplane Configuration Plot program (4407) be exercised as a check for input errors.

Program 4652, a grouping of several design programs under an executive program, contains a wave drag program, FFWD, which is substantially the same as 4404.

An auxiliary program, P4743, permits conversion of wave drag format input data into VORLAX (P4565) format. A related program, P4731, permits conversion of VORLAX format input data into the wave drag format.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4406 | WETTED AREA CALCULATION |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 BATCH FORTRAN | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Norma Brunkhardt | T. J. Jones | 7-2564 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 7-2852 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.2 MU/CASE | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 134 K | 1/2 |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| 1 pg NASA Writeup | 4/24/73 |

STATUS
Current
Output interpretation needed.

ABSTRACT

The program computes the surface wetted areas and reference lengths of each component of an airplane described in the standard wave drag geometry input format (Programs 4404, 4407). The airplane surface is approximated by various shapes. The surface areas and reference lengths are computed using the common formulas of geometry. Areas of roots and tips of wings and other surfaces are included in the computations. The output areas and lengths are necessary inputs for skin friction programs such as 4408, CF, or SKIN.

Presently this program, 4406, is run automatically each time the wave drag program, 4404, is executed.

| REVISED | 11/16 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4407 | AIRPLANE CONFIGURATION PLOT |
| COMPUTING SYSTEM | TYPE |
| IBM 360 BATCH FORTRAN | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Norma Brunkhardt | T. J. Jones | 7-2564 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 7-2852 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.2 MU/FRAME | 0.4 MU/FRAME |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 134 K | 1.5 |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| NASA TM X-2074 + 27 Calac Mod Sheets | 4-4-75 |

STATUS
Current
and Adequate


ABSTRACT

The program generates automatic plots of an airplane numerical model which are especially useful in checking the accuracy of the model before its use in more expensive-to-run programs such as Wave Drag (Program 4404). Plot options include conventional three-view and oblique orthographic projections, as well as perspective, including stereoscopic, projections. Use of particular angles for a rotated orthographic results in a true isometric projection which can be scaled along each of its three major axes. This NASA-Langley developed program was obtained in 1973.

Options added at Calac permit calling for detail plots of fuselage cross sections and true isometric plots.

| | |
|---|---|
| | REVISED 11/76 |
| PROGRAM NUMBER OR ACRONYM<br>4408 or P440801 in DCAS | PROGRAM NAME<br>AIRPLANE/WIND TUNNEL MODEL SKIN FRICTION DRAG |
| COMPUTING SYSTEM<br>IBM 360 BATCH FORTRAN ~~and DCAS~~ | TYPE<br>AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Norma Brunkhart<br>(C. B. Craidon - NASA) | T. J. Jones | 7-2564 |
| ENGINEER | R. D. Elliott<br>(R. V. Harris - NASA) | R. D. Elliott | 7-2852 |

| COMPUTING COSTS—MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| 0.3 MU/CASE | |

| PROGRAM SIZE | |
|---|---|
| BYTES CORE | BOXES OF SOURCE CARDS |
| 134 K | 0.5 |

| DOCUMENTATION | |
|---|---|
| USERS MANUAL | LAST REVISED |
| 28 pg Writeup from NASA-Langley | 1970 |

STATUS

Needs more thorough documentation

ABSTRACT

The first of two separate programs included under the same general program number is 440801 - Airplane Turbulent Skin Friction Drag. It is intended for computation of skin friction drag of full scale airplanes, using the Sommer and Short T' method based on equilibrium wall temperature of a flat plate parallel to the flow. The effects of distributed roughness and temperature of the surfaces can be evaluated at arbitrary combinations of Mach number and altitude, using either the 1962 US Standard day or constant temperature increments therefrom. Input consists of the flight conditions (M, Alt.), wetted areas, reference lengths and form factors for all the components of the airplane and the mean roughness height and emittance of the surfaces.

The second program, 440802, is intended for calculation of scaled wind tunnel model skin friction drag. The program computes the laminar, turbulent, and mixed flow skin-friction drag coefficients of a model at wind tunnel test conditions. Input consists of the wind tunnel Mach number, temperature, and Reynolds number, wetted areas, form factors, reference lengths, and boundary layer transition location for each component. Wetted areas of the fuselage, however, may be calculated internally from dimensional input data.

The predecessor program, 2359, was substantially the same as 440801.



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| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| VORLAX 4565 or P4565VØ in DCAS | UNIFIED SUBSONIC-SUPERSONIC NON-PLANAR VORTEX LATTICE |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 BATCH FORTRAN | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | L. R. Miranda<br>W. M. Baker | L. R. Miranda<br>W. M. Baker | 7-6812 |
| ENGINEER | L. R. Miranda | L. R. Miranda | 7-6812 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 2-15 MU /attack angle | - |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 350 K | 2 |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| LR 27820 | Oct. 1976 |

**STATUS**

Current


ABSTRACT

The non-planar vortex lattice method has been generalized for application in subsonic and supersonic potential flow, and implemented in a computer program for the calculation of the load distribution and aerodynamic characteristics of arbitrary aircraft configurations. Good correlation with other theories and with experimental data has been achieved.

The configuration surface is subdivided into a large number of trapezoidal panels, each of which contains a skewed, or swept, horseshoe vortex whose transverse segment is located at the quarter chord element line of the panel. The normal components of velocity induced at the three-quarter chord points of each panel are calculated and constitute the coefficients of a system of linear equations relating the circulation values of the vortices to the magnitude of the normal velocities. The circulation values giving zero resultant crossflow at the control points are determined by solving the above system of equations for a given Mach number and angle of attack. The solution of the linear system is carried out by the Gauss-Seidel relaxation technique. Once the circulation strengths are known, the pressure coefficients are calculated, and the force and moment coefficients are determined by direct numerical integration. If desired, the flow field in the vicinity of the aircraft can also be determined. The ability to treat asymmetric flight conditions permits calculation of sideslip derivatives.




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| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4624 or P4624 in DCAS | SUPERSONIC WING DESIGN |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 Batch Fortran or DCAS | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | T. J. Jones | T. J. Jones | 7-2564 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 7-2852 |

| COMPUTING COSTS--MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| 4-5 MU/case | 0.1 MU/case |
| **PROGRAM SIZE** | |
| BYTES CORE | BOXES OF SOURCE CARDS |
| 134 K | 1 |

| DOCUMENTATION | |
|---|---|
| USERS MANUAL | LAST REVISED |
| NASA TND-7713 | Feb. 1974 |
| + 46 page writeup | April 1975 |
| STATUS | |
| Current | |


ABSTRACT

Linearized supersonic lifting surface theory is employed to find the combination of up to 8 loadings which will produce the least drag on a wing of arbitrary planform. The solution may be subject,if desired,to restraints on pitching moment and camber surface severity in addition to the basic restraint on lift. The optimized loading, the corresponding camber surface, and the resultant forces and moments are the primary data generated by the program.

In previous versions of this program there were found to be sporadic irregularities in the definition of the camber surface in the immediate vicinity of the wing leading edge. These could be corrected by a manual alteration, but in fact were more often ignored. A numerical procedure which approximates the strategy employed in manual elimination of irregularities has recently been devised and is now incorporated.

Predecessor programs were 2316 and 4398. Program 4652, a grouping of several design programs under an executive program, contains a wing design program, WDEZ, which is the logical successor to 4624. Up to 17 loading are used in the optimization, pressure constraints are admissible and fuselage and nacelle pressure field effects can be included in WDEZ.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4625 or P4625 in DCAS | SUPERSONIC WING ANALYSIS |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 Batch Fortran or DCAS | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | T. J. Jones | T. J. Jones | 7-2564 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 7-2852 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 1-2 MU/Case | - | NASA TND-7713 | Feb. 1974 |
| PROGRAM SIZE | | + 36 Page writeup | April 1975 |
| BYTES CORE | BOXES OF SOURCE CARDS | STATUS | |
| 135K | 1/2 | Current | |


## ABSTRACT

Linearized supersonic lifting surface theory is employed to calculate the aerodynamic characteristics of a warped wing of arbitrary planform. The theory applies to wings having negligible thickness and essentially planar camber surfaces. The program calculates lifting pressure distribution for the warped wing at a fixed attitude and the pressure distribution (per degree angle of attack) for a corresponding flat wing. These two pressure distributions are combined by superposition principles and integrated over the wing surface to obtain the variation of aerodynamic characteristics with changes in angle of attack. Input information consists basically of Mach number, wing planform description, and z-ordinates defining the warped wing camber surface. The primary information consists basically of Mach number, wing planform description, and z-ordinates defining the warped wing camber surface. The primary information obtained from the program includes warped and flat wing pressure distributions and lift, drag, pitching moment, and angle of attack relationships.

In the analysis mode, especially in application to flat wings with near sonic leading edges, large oscillations in local pressure coefficients were known to exist from the inception of the method. In the original method these oscillations were largely eliminated by introduction of a powerful 9 point smoothing formula which operated after an initial definition of unsmoothed pressure coefficients for all the wing elements. The smoothing operation necessitated an extension of the wing grid system for 4 elements behind the actual wing trailing edge, and thus effectively limited applications of the method to wings with supersonic trailing edges. For the

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4625 or P4625 in DCAS | SUPERSONIC WING ANALYSIS (continued) |

ABSTRACT (continued)

particular case of a flat wing with an exact sonic leading edge the oscillations were in fact divergent, and the only recourse was to avoid that condition by considering either a slightly subsonic or slightly supersonic leading edge. A following element sensing technique has now been incorporated in the program to eliminate the necessity for an integral smoothing routine. This provision also extends applicability of the method to wings with subsonic trailing edges.

The predecessor programs were 2317 and 4405. Program 4652 a grouping of several design programs under an executive program, contains an analysis program, ANLZ, which is the logical successor to 4625.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 4652 or P4652 in DCAS | SUPERSONIC DESIGN AND ANALYSIS SYSTEM |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 Batch Fortran or DCAS | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | T. J. Jones | R. J. Jones | 72564 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 72852 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| .2 - 10 MU/Run | 0.4 MU/Frame |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 260K | 10 |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| NASA CR 2520<br>CR 2521<br>CR 2522 | Nov. 1974 |

STATUS

Current

## ABSTRACT

An integrated system of computer programs has been developed for the design and analysis of supersonic configurations. The system uses linearized theory methods for the calculation of surface pressures and supersonic area rule concepts in combination with linearized theory for calculation of aerodynamic force coefficients. The integrated system consists of an executive "driver" and seven basic computer programs including a geometry input module, which are used to build up the force coefficients of a selected configuration.

The main subprograms and the comparable separate program (if available) are as follows:

| Subprogram | P4652 Name | Separate Prog. Name |
|---|---|---|
| Geometry Module | GEØM | - |
| Configuration Plot | PLØT | P4407 |
| Skin Friction | SKFR | P440801 |
| Near Field Pressure Integration | NFWD | - |
| Far Field Wave-Drag | FFWD | P4404 |
| Wing Design and Optimization | WDEZ | P4624 |
| Wing Analysis | ANLZ | P4625 |

Use of the design system is superior to exercising individual programs in that data is passed automatically from one program to another without the need for punched cards or other interface methods. Also, overall CPU and elapsed time are reduced for a given analysis. In addition, wing-fuselage and wing-nacelle interference effects not available in separate programs are included.



LOCKHEED CALIFORNIA COMPANY

| REVISED 11/76 | | | |
|---|---|---|---|
| PROGRAM NUMBER OR ACRONYM<br>4731<br>VORTWD | PROGRAM NAME<br>VORLAX TO WAVE DRAG INPUT CONVERSION PROGRAM | | |
| COMPUTING SYSTEM<br>IBM FORTRAN DCAS | TYPE<br>AERODYNAMIC COEFFICIENT | | |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | T. J. Jones | T. J. Jones | 7-2564 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 7-2852 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 0.3 MU/CASE | - | LR 27645 | 8/76 |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | Nearly current | |
| 250 K | 9 pages of code | | |


ABSTRACT

A program developed to convert the VORLAX input geometry description into the Wave Drag input geometry description has two purposes: 1) to permit plotting of the configuration geometry in "wire frame" form as a check on input errors; 2) to save time and reduce human drudgery when configurations for which the geometry was first digitized in the VORLAX format is also to be analyzed for wave drag.

While the present version of VORTWD does not convert all VORLAX input options, it does handle the most common ones. It is recommended that all newly created VORLAX data sets be converted and plotted to validate the input geometry.




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| REVISED 11/76 | | | |
|---|---|---|---|
| PROGRAM NUMBER OR ACRONYM<br>P4743<br>WDTVOR | PROGRAM NAME<br>WAVE DRAG TO VORLAX INPUT CONVERSION PROGRAM | | |
| COMPUTING SYSTEM<br>IBM FORTRAN DCAS | TYPE<br>AERODYNAMIC COEFFICIENT | | |
| | ORIGINATING | CURRENT | PHONE |
| PROGRAMMER | R. D. Elliott | T. J. Jones | 7-2569 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 7-2852 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING<br>0.3 MU/CASE | PLOTTING<br>1 | USERS MANUAL<br>LR 27749 | LAST REVISED<br>7/76 |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE<br>250 K | BOXES OF SOURCE CARDS<br>17 pages of code | Nearly current | |


ABSTRACT

The purpose of a program called WDTVOR, developed to convert the Wave Drag input geometry into the VORLAX input geometry description, is to save time, improve accuracy, and reduce human drudgery when configurations for which the geometry was first digitized in the Wave Drag format are also to be analyzed on the VORLAX program.

The present version of WDTVOR contains the option to convert fuselages to flat plates having the current planform area or to a simulation having hexagonal cross sections. All wings and planer surfaces are converted to zero thickness panels although the wing camber effects are preserved. Engine pods are converted as curved panels approximated by hexagons.

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| AERO, FØIL | AIRFOIL SECTION GEOMETRY DEFINITION |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM CPS | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | L. R. Miranda | L. R. Miranda | 7-6812 |
| ENGINEER | L. R. Miranda | L. R. Miranda | 7-6812 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| - | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 6.7 K | 3 pages of code |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| none | |

STATUS

ABSTRACT

Develops an analytically smooth airfoil section definition from a minimum number of specified inputs such as leading edge radius, trailing edge slope, maximum thickness coordinates, T.E. ordinate and two others.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| CF, LRM | VAN DRIEST SKIN FRICTION WITH WETTED AREA CALCULATION |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CPS | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | L. R. MIRANDA | L. R. MIRANDA | 7-6812 |
| ENGINEER | L. R. MIRANDA | L. R. MIRANDA | 7-6812 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.1 MU/CASE | ____ |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 15 K | 4 PAGES OF CODE |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| NONE | ____ |

STATUS

NEEDED

ABSTRACT

The program computes the skin friction drag coefficient of a complete aircraft by use of Van Driest's formula for adiabatic wall from the wetted areas and reference lengths of each component. An option permits calculation of wetted areas from input of aircraft dimensional data. Output is suitable for direct inclusion in reports.

This program is presently stored in CPS used library E5A.

| | REVISED 11/76 |
|---|---|
| PROGRAM NUMBER OR ACRONYM<br>delta, method | PROGRAM NAME<br>EMPIRICALLY BASED - TRANSONIC AIRCRAFT - TOTAL DRAG PREDICTION TECHNIQUE - DELTA METHOD |
| COMPUTING SYSTEM<br>IBM CPS | TYPE<br>AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | C. W. Bogart | C. W. Bogart | 72854 |
| ENGINEER | C. W. Bogart | C. W. Bogart | 72854 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| | - | LR 27027 | 1 June 1976 |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | Reasonably Current | |
| 14 K | - | | |


ABSTRACT

Accurate drag prediction of airplanes has been documented in LR 27027. This program comes from the methods and data of that report. Input data consist of component geometry. Output is a component drag buildup, $C_D$ vs $C_L$, Mach at cruise altitude, and a table showing changes in drag due to changes in Reynolds number.

Currently stored in CPS library E5E.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| HALPS, HELPS | HIGH AERODYNAMIC LIFT PARAMETRIC SYNTHESIS |
| COMPUTING SYSTEM<br>IBM 360 CPS | TYPE<br>AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | R. D. Elliott | R. D. Elliott | 7-2852 |
| ENGINEER | W. D. Morrison | W. D. Morrison | 7-5593 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.1 MU/case | |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 8.2 K bytes | 3 pages of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| IDC FS/74-13-02-1020 | June 1974 |

**STATUS**

Current

**ABSTRACT**

A method for estimating high lift (flapped) drag polars based on Royal Aeronautical Society (RAS) Data Sheets has been developed for incorporation into the ASSET program. Basic data was adjusted to match the L-1011-385-1 design. Therefore the method is valid (in the strict sense) only for subsonic transport type aircraft having reasonably similar plan design characteristics. The method does, however, provide good agreement with test data for off-baseline configurations such as the Electra/P-3 aircraft.

The program is presently available in the CPS library E5A.



LOCKHEED

| REVISED | 11/76. |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| SKIN | AIRCRAFT SKIN FRICTION DRAG BUILD UP |
| COMPUTING SYSTEM | TYPE |
| IBM 360 CPS | AERODYNAMIC COEFFICIENT |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | E. B. BLOOD | NONE | |
| ENGINEER | E. B. BLOOD | NONE (SEE R. D. ELLIOTT OR L. R. MIRANDA) | 7-2852 |

| COMPUTING COSTS--MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| 0.1 MU/CASE | —— |

| PROGRAM SIZE | |
|---|---|
| BYTES CORE | BOXES OF SOURCE CARDS |
| 10.5 K | 3 PAGES OF CODE |

| DOCUMENTATION | |
|---|---|
| USERS MANUAL | LAST REVISED |
| IDC L1011-8/ AERO/69-31 | 12/69 |
| STATUS | |
| CURRENT | |

ABSTRACT

The program computes turbulent skin friction of aircraft components using the method of Sommer & Short. The program is similar to Batch Program # 440801 and results are in agreement. Non-standard days, surface emittance and roughness height are not variables in the SKIN program.

The program is available in the CPS Public Library.

# SECTION 2

# AERODYNAMIC PERFORMANCE PROGRAMS

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 2252 | ENERGY MANEUVERABILITY |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM-360 BATCH FORTRAN | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | W. J. HARLEY | R. E. POSTHUMUS | 7-2059 |
| ENGINEER | N. T. AVANT | R. D. ELLIOTT | 7-2852 |

| COMPUTING COSTS--MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| .05-0.2 MU/Plot | 0.07-0.7 MU/Plot |

| PROGRAM SIZE | |
|---|---|
| BYTES CORE | BOXES OF SOURCE CARDS |
| 300 K | 3 |

| DOCUMENTATION | |
|---|---|
| USERS MANUAL | LAST REVISED |
| LR 20793 | 8/1/67 |

STATUS

IN NEED OF REVISION

ABSTRACT

The Energy-Maneuverability Program calculates, prints, and plots contours of certain aircraft performance parameters in the speed-altitude plane. These parameters, called the contoured parameters, include weight, steady state load factor, steady state turn radius, steady state turn rate, energy additive rate, differential specific excess power, airplane/engine efficiency index, energy-maneuverability efficiency, instantaneous load factor, instantaneous turn radius, and instantaneous turn rate, or differential specific excess power. The latter capability can be used to show graphically the margin of specific excess power (energy additive rate) of one airplane over another. Lines of constant specific energy may be superimposed over energy additive rate, differential specific excess power, airplane/engine efficiency index, and energy-maneuverability efficiency contours. Furthermore, if desired, weight contours in the thrust-Mach and/or drag-Mach plane may be calculated and plotted.

Input consists of specified power tables, configuration (drag) tables, speed placard tables, $C_{L_{max}}$ tables, and certain control cards and aircraft description data.



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| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 2955, or P2955 in DCAS | MISSION ANALYSIS |
| COMPUTING SYSTEM | TYPE |
| IBM 360 BATCH FORTRAN in DCAS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | R. E. POSTHUMUS | R. E. POSTHUMUS | 7-2059 |
| ENGINEER | R. D. ELLIOTT | R. D. ELLIOTT | 7-2852 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.2-2.5/MISSION | |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 306 K | 5 |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| LR 17546 | 11/16/73 |

**STATUS**

Current for MARK X version needs revision to MK XI


## ABSTRACT

Airplane mission performance is calculated from basic data describing aerodynamic characteristics, propulsion characteristics, weight breakdown, and a mission profile. Typical solvable problems include maximum radius, maximum range, maximum time-on-station, and payload for a fixed range. The approximate 2-dimensional point mass equations of motion employed neglect normal acceleration and rotational inertias. Optional corrections are provided to partially account for curved flight about a spherical earth. Computation sequence is chronological--in the order the mission would be flown. Special features include the ability to fly paths producing constant sonic boom intensity and an atmosphere subroutine permitting arbitrary temperature-altitude profiles. Nine types of cruise flight are permitted including constant or optimum altitude at optimum Mach, constant or optimum altitude at constant Mach, constant or optimum altitude at the Mach for thrust equals drag, and others. In addition, there are four ways to loiter at minimum fuel flow. Climb or descent along constant EAS, CAS, or arbitrary Mach-altitude schedules to specified weights, altitudes, or times is available. Acceleration or deceleration at constant altitude to specified weights, Mach numbers, distances, EAS, CAS, or times is permitted. Normal summary page print output may be supplemented by time history print for selected segments. A larger version of the program may also be used to generate climb, descent, acceleration, subsonic and supersonic cruise, and loiter segment data in two forms: summary plots suitable for inclusion in performance reports, and punched cards suitable as input to the Calac Marketing Division's Economic Route Analysis Program.




LOCKHEED CALIFORNIA COMPANY

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| AIRPERFO.PLI | AIRLINE FLIGHT RECORDER PERFORMANCE DATA COMPARISON |
| COMPUTING SYSTEM | TYPE |
| IBM PL/I DCAS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | G. E. Carichner | " | 76736 |
| ENGINEER | G. E. Carichner | " | 76736 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 1 MU/FLIGHT | - | None | |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| 25K | 13 pages of coding | | |


ABSTRACT

Reads flight recorder data for basic aircraft performance. Based on the computed drag from flight recorder and representative thrust and fuel flow maps and drag polars, a theoretical profile is calculated. This theoretical profile may be either a fixed cruise Mach number or an optimum Mach number (computed by program) along with a fixed climb schedule. Side by side comparison of actual and theoretical results are output. Also included, is a statistical drag summary based on the actual flight data.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| DIVE, MLBAX | DIVE TIME HISTORY |
| COMPUTING SYSTEM | TYPE |
| IBM 360 CPS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | M. L. Baxendale | M. L. Baxendale | 7-6812 |
| ENGINEER | M. L. Baxendale | Baxendale/Bogart | 7-2854 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.2 MU/dive | - |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 11.2K | 4 pages of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| None | 3-12-74 |

**STATUS**

Would be useful.

**ABSTRACT**

The time history of a dive maneuver is computed, including push-over, constant-dive angle dive, and an iterated pull-up initiation altitude such that the bottom of the pullout is at 2,000 ft. Inputs include weight, initial speed and altitude, and push-over. Elapsed time to run one case is five minutes. Currently stored in CPS Library E5M.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| LIMWGT,AERØ | LIMIT WEIGHT |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM CPS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | E. Q. Bond | G. E. Carichner | 7-6736 |
| ENGINEER | E. Q. Bond | G. E. Carichner | 7-6736 |

| COMPUTING COSTS--MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| 0.05 MU/Case | - |

| PROGRAM SIZE | |
|---|---|
| BYTES CORE | BOXES OF SOURCE CARDS |
| 11.3K | 3 pages of code |

| DOCUMENTATION | |
|---|---|
| USERS MANUAL | LAST REVISED |
| None | |

STATUS

Would be useful.

ABSTRACT

The maximum weight obtainable at a specified altitude, flap setting, and temperature increment from standard day is calculated and the optimum speed for it is noted.

Currently stored in CPS Library E5E.

Reference: Computer Services Batch Program #3329 (inactive).

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| MISS, VIKING | MISSION PERFORMANCE |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CPS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Ron Moran | M. L. Baxendale | 7-6812 |
| ENGINEER | Ron Moran | M. L. Baxendale | 7-6812 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.02-0.2 MU/Mission | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 10.5K | 4 pages of code |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

STATUS

Would be useful

ABSTRACT

Computes military-type missions such as time on station at sea level or optimum altitude with cruise at optimum altitude, tanker missions, and payload-range missions utilizing segment data previously computed on the 360 Batch Process Program 2955 . This segment data is input tabulated mono or bivariate form, which is simpler to change than fitted analytic equations, but takes longer to compute because of the need for calling and returning tables to and from files and using external subroutines NUTRP1 and NUTRP2 for parabolic interpolation. Elapsed time for one mission is approximately 5 minutes. Weight, fuel, distance, and some times for each mission segment are output.

Currently stored in CPS Library E5M.



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| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| NATØPS, (no key) | MISSION PERFORMANCE - S-3A |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CPS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | M. L. Baxendale | M. L. Baxendale | 7-6812 |
| ENGINEER | M. L. Baxendale | M. L. Baxendale | 7-6812 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| .02 to 0.2 MU/mission | - |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 12K | 3 pages of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

**STATUS**

Would be useful


ABSTRACT

Computes military-type missions such as time-on-station at sea level or optimum altitude with cruise at optimum altitude, tanker missions, and payload-range missions utilizing segment data previously computed on the batch mission program, 2955. This segment data is input via coefficients of polynomial equations fitted to the data. Otherwise the program is similar to and derived from MISS,VIKING. Weight, fuel, distance, and some tines for each mission segment are output.

Currently stored in CPS library E5M.




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| | | | |
|---|---|---|---|
| | | | REVISED 11/76 |

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| ROC, GEC # | RATE OF CLIMB |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CPS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | G. E. Carichner | G. E. Carichner | 7-6736 |
| ENGINEER | G. E. Carichner | G. E. Carichner | 7-6736 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 0.1 to 0.2 MU/Case | - | None | |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| 12.2 K | 4 pages of code | Requirement marginal | |

ABSTRACT

Two problem types are solved: (1) For all combinations of weight and altitude the instantaneous rate of climb is calculated for a specified Mach number. (2) For all weights the maximum altitude is calculated for a given rate of climb and Mach number. Input options include a choice of constant Mach, EAS, or Mach vs. altitude climb schedules. The program is often used for maximum speed capability by asking for R/C = 0.

Currently stored in CPS Library E5E.



LOCKHEED
CALIFORNIA COMPANY

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| TOFF. PLI | TAKEOFF PERFORMANCE |
| COMPUTING SYSTEM | TYPE |
| IBM 360 PL/I DCAS | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | G. E. Carichner | G. E. Carichner | 7-6735 |
| ENGINEER | G. E. Carichner | G. E. Carichner | 7-6735 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.2 MU/Case | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 27 K | 13 pages of code |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

STATUS

Would be useful

ABSTRACT

Takeoff field length is calculated based on flight test data and methodology under FAA rules. The segmented takeoff uses the RMS speed point in each segment for calculation of the average force in that segment. Capabilities include solving for the second-segment limit weight, balanced and unbalanced conditions with clearway/stopway-available, tire speed limit, runway slope, winds, brake energy limited performance, and overspeed.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| TAKEOFF | INTERACTIVE TAKEOFF TIME HISTORY |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 Batch PL and IBM 370 TSO | PERFORMANCE |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | R. D. Elliott | T. J. Jones | 72565 |
| ENGINEER | R. D. Elliott | R. D. Elliott | 72852 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.2 MU/CASE | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 60 K | 20 pages of code |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| 55 pages (CPS) | May 1975 |
| 20 pages (TSO-PL/I) | May 1975 |

STATUS

Current

ABSTRACT

A time history, performance takeoff capability has been developed, which treats acceleration from start of ground roll to rotation speed, rotation to liftoff speed, the airborne trajectory from liftoff to 35 feet altitude, and the climb from 35 feet to the 3.5 nautical mile point.

Constraints on maximum load factor and pitch attitude are imposed so as to produce trajectories with equivalent airspeed relatively constant. Other features include treatment of runway slope, non-standard days, headwinds, landing gear retraction, and monitoring of tail scrape angle. Not yet available are engine failure analysis or balanced field length calculations, thrust cutback, or flap angle change during climbout.

The program is available as a batch PL/I program (non-interactive) as well as a TSO (time Sharing Option) program on the IBM 370-168 (interactive).

# SECTION 3

## STABILITY AND CONTROL PROGRAMS

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 3089<br>REXØR | ROTOCRAFT SIMULATION MODEL |
| COMPUTING SYSTEM | TYPE |
| IBM 360 Batch Fortran | STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Unknown | P. Kretsinger | 75140 |
| ENGINEER | Unknown | S. Reaser | 72097 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 15 MU/CASE | | USAAMRDL TR-76-28A,B,C | March, 1976 |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| 225 K | 2-1/2 | Current | |

ABSTRACT

The REXOR math model has been written for a single four-bladed, gyro controlled, hingelss-rotor helicopter with additional capability for analysis of teetering or hinge-offset rotor systems with conventional controls and two or four blades. Modeling emphasis is on an accurate main rotor description.

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 3626 | SMALL PERTURBATION HELICOPTER ANALYSIS MODEL |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 Batch Fortran | STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | Feinstein | P. Kretsinger | 75140 |
| ENGINEER | S. Reaser | S. Reaser | 72097 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 1 | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 350 K | 2 |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| Limited Distribution | Unknown |

STATUS

Out of date

ABSTRACT

Program trims an input helicopter configuration and calculates linear model derivatives required. The linear model (20 x 20) is internally assembled and linked to the CSAP matrix analysis package maintained by Scientific Computer Services.

| | |
|---|---|
| | REVISED 11/76 |
| PROGRAM NUMBER OR ACRONYM<br>ADMP, AERO | PROGRAM NAME<br>AIRCRAFT DYNAMIC MODES PROGRAM |
| COMPUTING SYSTEM<br>IBM CPS | TYPE<br>Stability and Control |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | G. Blausey | R. Ptachick | 7-5608 |
| ENGINEER | G. Blausey | R. Ptachick | 7-5608 |

| | | | |
|---|---|---|---|
| COMPUTING COSTS---MACHINE UNITS | | DOCUMENTATION | |
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 0.02 MU/CASE | - | None | |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | Would be useful | |
| 16 K | 5 pages | | |

ABSTRACT

The program is capable of solving the Longitudinal and Lateral-Directional dynamic stability oscillatory roots using linearized aerodynamic derivatives. It computes the frequency, damping ratio and period for short period, phugoid, dutch roll, damping in roll and spiral mode.

Presently stored in CPS user library E5E.

| | REVISED 12/22/75 |
|---|---|
| PROGRAM NUMBER OR ACRONYM<br>ASAP | PROGRAM NAME<br>ADVANCED SYSTEMS ANALYSIS PROGRAM |
| COMPUTING SYSTEM<br>IBM 360 GRAPHICS | TYPE<br>STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | H. P. Weinberger | E. Sturcke | 7-8104 |
| ENGINEER | H. P. Weinberger | M. S. Eden | 7-5608 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.04 MU/Case | 0.03 MU/Plot |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 126K | 4 boxes |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| 31 page ASAP Users Manual | Sept. 1974 |

STATUS

Current

ABSTRACT

ASAP is an Interactive Graphical Systems Analysis Program for solution and analysis of a system of linear differential equations expressed in polynomials of the Laplace operator S. Input may be in either matrix or equation form. Outputs available are Root Locus, Bode plot, time response, and power spectral density.

ASAP interfaces with other related graphics programs such as TRIM, 6DØF, and REP ØP.



LOCKHEED CALIFORNIA COMPANY

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| BODYAX, jjr | BODY AXES DERIVATIVES |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM CPS | STABILITY & CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | J. J. Rising | J. J. Rising | 75608 |
| ENGINEER | J. J. Rising | J. J. Rising | 75608 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| | | none | |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| | 1 page of code | | |


ABSTRACT

This program converts aerodynamic coefficients and stability and control derivatives from the stability axes to a body axes system.

Presently stored in CPS user library E5A.

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| DIMDER, jjr | DIMENSIONAL DERIVATIVES |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM CPS | STABILITY & CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | J. J. Rising | J. J. Rising | 75608 |
| ENGINEER | J. J. Rising | J. J. Rising | 75608 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| | | None | |
| **PROGRAM SIZE** | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| | 2 pages of code | | |

ABSTRACT

This program calculates body-axis dimensional stability and control derivatives. Input includes the nondimensional derivaties, both longitudinal and lateral-directional, and the flight conditions.

Presently stored in CPS user library- E5A.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| ftae, pfb | PITCH DATA EXTRACTION FROM FLIGHT TEST DATA - S3A |
| COMPUTING SYSTEM: IBM 360 CPS | TYPE: STABILITY & CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | P. F. Bala | P. F. Bala | 7-5592 |
| ENGINEER | P. F. Bala | P. F. Bala | 7-5592 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.1 Mu/case | |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 7.5K | 2 pages of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| 1 page writeup | 11/4/75 |

**STATUS**

Adequate


ABSTRACT

This program extracts longitudinal pitch characteristics from steady state S-3A flight test data, using the estimated control effectiveness data. The equations assume three degrees of longitudinal freedom with zero pitch and alpha accelerations. The program can be modified by use on aircraft by changing the aircraft geometry, engine data and control effectiveness data.

Presently stored in CPS user library E5M.

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| LADCØF, jjr | LATERAL-DIRECTIONAL TRANSFER FUNCTIONS |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM CPS | STABILITY & CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | J. J. Rising | J. J. Rising | 7-5608 |
| ENGINEER | J. J. Rising | J. J. Rising | 7-5608 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| | - |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| | 1 page of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| none | |

STATUS

## ABSTRACT

This program calculates the numerator and characteristic coefficients for basic airframe lateral-directional transfer functions.

Presently stored in CPS user library E5A.

| REVISED | 11/76. |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| LATTDY, MSE | LATERAL DIRECTIONAL DYNAMIC TIME HISTORY |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CPS | Stability and Control |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | M. S. Eden | M. S. Eden | 7-5608 |
| ENGINEER | M. S. Eden | M. S. Eden | 7-5608 |

| COMPUTING COSTS---MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 0.2 MU/CASE | - | None | |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| 8.7 | 2 pages of code | Requirement marginal | |

ABSTRACT

A linearized Lateral-Directional three degrees of freedom program permits calculation of airplane response characteristics due to various disturbances using basic aerodynamic data.

Presently stored in CPS user library E5E.

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| lngrm, pfb | LONGITUDINAL TRIM AND MANEUVERABILITY |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM CPS | STABILITY & CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | P. F. Bala | P. F. Bala | 7-5592 |
| ENGINEER | P. F. Bala | P. F. Bala | 7-5592 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| | |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| | |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

STATUS


ABSTRACT

Trim stabilizer and elevator deflections are converted for the powered S-3A control system. In addition, maneuvering elevator and stick forces per g are calculated. The program could be modified for use on other aircraft.

Presently stored in CPS library E5M.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| LONCOF, jjr | LONGITUDINAL TRANSFER FUNCTIONS |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM CPS | STABILITY & CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | J. J. Rising | J. J. Rising | 75608 |
| ENGINEER | J. J. Rising | J. J. Rising | 75608 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| | - |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| | 1 page of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| none | |

**STATUS**

**ABSTRACT**

This program calculates the numerator and characteristic coefficients for basic airframe longitudinal transfer functions.

Presently stored in CPS user library E5A.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| long, pfb | LONGITUDINAL TRIM AND MANEUVERABILITY ON MANUAL CONTROL SYSTEM INCLUDING TRANSFER FORCES |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM CPS | STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | P. F. Bala | P. F. Bala | 7-5592 |
| ENGINEER | P. F. Bala | P. F. Bala | 7-5592 |

| COMPUTING COSTS--MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| 0.2 MU/CASE | - |

| PROGRAM SIZE | |
|---|---|
| BYTES CORE | BOXES OF SOURCE CARDS |
| 10K | 3 pages of code |

| DOCUMENTATION | |
|---|---|
| USERS MANUAL | LAST REVISED |
| None | |

STATUS

Requirement marginal

ABSTRACT

Low speed longitudinal trim surface deflection and aerodynamic hinge moments are computed for both the powered and manual control systems. The steady-state powered-to-manual transfer forces can be determined as well as maneuvering control capability on both systems. Program is presently stored in CPS Library E5M.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| LONG, RJP | LONGITUDINAL TIME HISTORY |
| COMPUTING SYSTEM | TYPE |
| IBM 360 CPS | Stability and Control |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | R. J. Ptachick | R. J. Ptachick | 7-5608 |
| ENGINEER | R. J. Ptachick | R. J. Ptachick | 7-5608 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.2 MU/CASE | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 10.4 K | 3 pages of code |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

STATUS

Would be useful

ABSTRACT

A linearized longitudinal three degrees of freedom program referred to stability axes permits calculation of airplane response characteristics due to various disturbing actions such as stabilizer deflection thrust pulsation and control system failure as a function of time.

Presently stored in CPS user library E5E.

REVISED 11/76

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| MATRIX, HEIM | 3 x 3 MATRIX ANALYSIS PROCEDURE |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM CPS | STABILITY & CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | T. Heim | | |
| ENGINEER | T. Heim | S. Reaser | 72097 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| | |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 8 K including subroutines | |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| Self instructing | |

**STATUS**

not required


## ABSTRACT

This program accepts analysis models expressed in S plane up to a degree of freedom with up to 3 forcing functions. User output selection includes roots, transfer function, frequency response and time histories.

The program is currently on CPS library E5C.




LOCKHEED CALIFORNIA COMPANY

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| NGLO, CLIVE | MINIMUM NOSE GEAR LIFT OFF SPEED |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CPS | Stability and Control |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | R. J. Ptachick | R. J. Ptachick | 7-5608 |
| ENGINEER | R. J. Ptachick | R. J. Ptachick | 7-5608 |

**COMPUTING COSTS—MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.1 MU/CASE | - |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 3.5 K | 1 page of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

**STATUS**

Requirement marginal

ABSTRACT

Minimum nose wheel lift off speed and corresponding main gear reaction forces are calculated from basic geometric and aerodynamic coefficient inputs.

Presently stored in CPS user library E5E.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| MANV, RJP | STABILIZER PER G - L1011 |

| COMPUTING SYSTEM | TYPE |
|---|---|
| IBM 360 CPS | Stability and Control |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | R. J. Ptachick | R. J. Ptachick | 7-5608 |
| ENGINEER | R. J. Ptachick | R. J. Ptachick | 7-5608 |

**COMPUTING COSTS--MACHINE UNITS**

| COMPUTING | PLOTTING |
|---|---|
| 0.1 MU/CASE | - |

**PROGRAM SIZE**

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 7.6 K | 2 pages of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

STATUS

Would be useful

ABSTRACT

The maneuvering longitudinal characteristics for wind-up turn maneuver for positive load factor and wings-level push-over for negative load factor may be computed.

Presently stored in CPS user library E5E.

| | |
|---|---|
| | REVISED 11/76 |
| PROGRAM NUMBER OR ACRONYM<br>REAS01 | PROGRAM NAME<br>THREE LOOP NYQUIST ANALYSIS |
| COMPUTING SYSTEM<br>IBM CPS | TYPE<br>STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | S. Reaser | S. Reaser | 72097 |
| ENGINEER | S. Reaser | S. Reaser | 72097 |

| | |
|---|---|
| COMPUTING COSTS--MACHINE UNITS<br>COMPUTING PLOTTING | DOCUMENTATION<br>USERS MANUAL LAST REVISED<br>Limited Distribution |
| PROGRAM SIZE<br>BYTES CORE: 6K including subroutines<br>BOXES OF SOURCE CARDS | STATUS<br>Current |

ABSTRACT

The program accepts a plant model in S plane notation plus two additional forward blocks of third order over third order. Each forward network element has a third order feedback block. Frequency response is calculated for successive loop closures.

The program is currently on CPS library E5C.

| REVISED | 12/22/75 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| REP, ØP | PERTURBATION MATRIX PROGRAM |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CSMP | STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | M. S. Eden | M. S. Eden | 7-5608 |
| ENGINEER | M. S. Eden | M. S. Eden | 7-5608 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.05 MU/Case | - |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 126K | 1/2 box |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| LR 26533 | |

STATUS

To be published.

ABSTRACT

The dynamic longitudinal and lateral or coupled matrices are set up using a perturbation technique applied to non-linear six-degree-of-freedom models. The model is initialized at a given flight Mach number and altitude at a given weight and center of gravity. Small perturbations are applied to each state variable. The program will rapidly scan a large number of tabulated flight conditions. Matrices are automatically transferable to ASAP for roots, Bode, Root Locus, and Power Spectral Density analyses.

Other related graphics programs which interface with REP ØP are TRIM and 6 DØF.

| | | | |
|---|---|---|---|
| | | REVISED | 11/76 |
| PROGRAM NUMBER OR ACRONYM<br>SIDE, SLIP | PROGRAM NAME<br>STEADY SIDESLIP | | |
| COMPUTING SYSTEM<br>IBM 360 CPS | TYPE<br>Stability and Control | | |
| | ORIGINATING | CURRENT | PHONE |
| PROGRAMMER | R. J. Ptachick | R. J. Ptachick | 7-5608 |
| ENGINEER | R. J. Ptachick | R. J. Ptachick | 7-5608 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 0.1 MU/CASE | - | None | |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| 9.4 K | 3 pages code | Would be useful | |

## ABSTRACT

The airplane Lateral-Directional steady sideslip characteristics are computed with or without asymmetric thrust from basic aerodynamic and thrust inputs.

Presently stored in CPS user library E5E.



LOCKHEED CALIFORNIA COMPANY

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| 6 DØ F | SIX-DEGREE-OF-FREEDOM TIME HISTORY |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CSMP GRAPHICS | STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | M. S. Eden | M. S. Eden | 7-5608 |
| ENGINEER | M. S. Eden | M. S. Eden | 7-5608 |

COMPUTING COSTS--MACHINE UNITS

| COMPUTING | PLOTTING |
|---|---|
| 0.2 MU/40 SEC HISTORY | 0.03 MU/Plot |

PROGRAM SIZE

| BYTES CORE | BOXES OF SOURCE CARDS |
|---|---|
| 126K | 1 box |

DOCUMENTATION

| USERS MANUAL | LAST REVISED |
|---|---|
| LR 26533 | |

STATUS

Unpublished

ABSTRACT

Six-degree-of-freedom airplane maneuvers may be calculated in the air or during landing and takeoff. Included are aerodynamic controls, engine controls, and braking and steering logic consistent with FAR 25. Free form modeling techniques enabled by a self-sorting translator are utilized. Hard copy plots are available from microfilm. Related graphics programs which interface with 6 DØF are TRIM, ØP, and ASAP.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| TOL, MSE | LEAST SQUARES BIVARIATE CURVE FIT |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM CPS | STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | M. S. Eden | M. S. Eden | 7-5608 |
| ENGINEER | M. S. Eden | M. S. Eden | 7-5608 |

| COMPUTING COSTS--MACHINE UNITS | |
|---|---|
| COMPUTING | PLOTTING |
| 0.7 MU/case | - |

| PROGRAM SIZE | |
|---|---|
| BYTES CORE | BOXES OF SOURCE CARDS |
| 11.4K | 2 pages of code |

**DOCUMENTATION**

| USERS MANUAL | LAST REVISED |
|---|---|
| None | |

STATUS Would be useful. Possible candidate for CPS Public Library.


ABSTRACT

A least squares fit relates a dependent variable FN of two independent variables (N1, MA) in the form of cross polynomials. The program is currently set up for up to 88 data points (M), up to 20 polynomial functions (N). The polynomials are cubic in the independent variable N1 and quartic in MA. The least squares fit is characterized by coefficients C (1-N).

Arbitrary functions can be used in place of the polynomial function F.

Program has general application other than stability and control. Currently in CPS Library E5E.

| REVISED | 11/76 |
|---|---|

| PROGRAM NUMBER OR ACRONYM | PROGRAM NAME |
|---|---|
| TRIM | TRIM PROGRAM |
| **COMPUTING SYSTEM** | **TYPE** |
| IBM 360 CSMP GRAPHICS | STABILITY AND CONTROL |

| | ORIGINATING | CURRENT | PHONE |
|---|---|---|---|
| PROGRAMMER | M. S. Eden | M. S. Eden | 7-5608 |
| ENGINEER | M. S. Eden | M. S. Eden | 7-5608 |

| COMPUTING COSTS--MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 0.2 MU/Case | - | LR 26533 | |
| **PROGRAM SIZE** | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | Unpublished | |
| 126K | 1/2 box | | |

## ABSTRACT


Static analyses are performed for an airplane given freely expressed aerodynamic, geometric, and engine data. Typical modes of operation are:

- Steady Level Flight - vary speed.
- Power and/or Roll Asymmetry - vary speed.
- Steady Climb - vary speed.
- Vertical Acceleration - vary Θ.
- Wheels on Ground - vary speed

and any logical combination of the above. Related graphics programs which interface with TRIM are REP ØP, ASAP, and 6 DØF.

| | | | REVISED 11/76 |
|---|---|---|---|
| PROGRAM NUMBER OR ACRONYM<br>TRIM, AERO | PROGRAM NAME<br>TRIM FOR LEVEL FLIGHT - L1011 | | |
| COMPUTING SYSTEM<br>IBM 360 CPS GRAPHICS | TYPE<br>Stability and Control | | |
| | ORIGINATING | CURRENT | PHONE |
| PROGRAMMER | R. J. Ptachick | R. J. Ptachick | 7-5608 |
| ENGINEER | R. J. Ptachick | R. J. Ptachick | 7-5608 |

| COMPUTING COSTS—MACHINE UNITS | | DOCUMENTATION | |
|---|---|---|---|
| COMPUTING | PLOTTING | USERS MANUAL | LAST REVISED |
| 0.1 MU/CASE | - | None | |
| PROGRAM SIZE | | STATUS | |
| BYTES CORE | BOXES OF SOURCE CARDS | | |
| 8.5 K | 2 pages of code | Requirement marginal | |

ABSTRACT

The one g longitudinal level flight trim characteristics with and without power effects are calculated from basic aerodynamic and thrust inputs.

Presently in CPS user file E5E.

# SECTION 4

# LIST OF INACTIVE PROGRAMS

# INACTIVE PROGRAMS

| PROGRAM NUMBER | PROGRAM NAME | LAST KNOWN ENGINEER | LAST KNOWN PROGRAMMER |
|---|---|---|---|
| 416 | BOMB DROP TRAJECTORY | R.D. Elliott | R.K. Prince |
| 2009 | TAKEOFF PERFORMANCE | R.D. Elliott | R.E.Posthumus |
| 2082 | ZERO LENGTH LAUNCH TRAJECTORY | R.C. Feagin | R.G. Sproul |
| 2191 | CONFIGURATION GENERATOR (BIVARIATE TABLE MANIPULATION) | R.D. Elliott | R.E.Posthumus |
| 2199 | DIVE TRAJECTORY INCLUDING PUSHOVER AND PULLOUT | C.W. Bogart | B.R.McCorkle |
| 2207 | SONIC BOOM OVERPRESSURE | L.M.Kenner | J.N. Meade |
| 2211 | PERFORMANCE MAPPING - SPEED ALTITUDE SUMMARY | N.T. Avant | R.E.Posthumus |
| 2225 | HAMILTON STANDARD PROPELLER PROGRAM | H.B.Crockett | E. Lipton |
| 2234 | DRAG COEFFICIENT PLOT | L.J. Aker | R.E.Posthumus |
| 2241 | DIVE TRAJECTORY | C.W. Bogart | B.R.McCorkle |
| 2250 | GENERALIZED ATMOSPHERE | R.D.Elliott | J.F.Holliday |
| 2296 | PROPULSION DATA PLOT | L.J. Aker | W.J. Harley |
| 2297 | ZERO LIFT WAVE DRAG | R.D.Elliott | T. J. Jones |
| 2301 | SUPERSONIC CAMBER & TWIST FOR SPECIFIED LOADING | R.D. Elliott | J.N. Meade |
| 2314 | M-n DIAGRAMS | G.C.Blausey | W.J. Harley |
| 2316 | SUPERSONIC CAMBER DESIGN - 3 LOADINGS | R.D. Elliott | J.N. Meade |
| 2317 | SUPERSONIC WING ANALYSIS PROGRAM | R.D. Elliott | D.M. Kaye |
| 2339 | 3-D STABILITY PROGRAM | B.T.Averett | R.G. Sproul |
| 2359 | AIRPLANE TURBULENT SKIN FRICTION | R.D.Elliott | T. J. Jones |
| 2383 | SUPERSONIC PRESSURE FIELD IN PRESENCE OF WING DUE TO NACELLES | L.M. Kenner | J.R. Boone |
| 2435 | AXISYMMETRIC POTENTIAL FLOW | C. Schwartz | D.Tappeiner |
| 2456 | WIND TUNNEL DATA MANIPULATION AND PLOT | R.D. Elliott | J.N. Meade |
| 2467 | WETTED AREA CALCULATION FROM WAVE DRAG | R.H. Shaar | J.N. Meade |
| 2470 | 5-D MANEUVER AND DYNAMIC MODES | C.F.Anderson | R.G. Sproul |
| 2513 | DRAG POLAR CURVE FIT | F.R.Bruckman | B.A.Galipeau |
| 2542 | SIX-DEGREE-OF-FREEDOM FLIGHT PATH GENERALIZED COMPUTER PROGRAM | E. Lloyd | J.Gilbertson |
| 2736 | SECOND ORDER THEORY FOR STEADY OR UNSTEADY SUBSONIC FLOW PAST SLENDER BODIES OF FINITE THICKNESS | J.D. Revell | T.J. Jones |
| 2739 | FULLY AUTOMATIC COMPUTER TECHNIQUE FOR SIZING (FACTS) | L.M. Kenner | W.J. Harley |

# INACTIVE PROGRAMS

| PROGRAM NUMBER | PROGRAM NAME | LAST KNOWN ENGINEER | LAST KNOWN PROGRAMMER |
|---|---|---|---|
| 2763 | ANALYSIS AND DESIGN OF WINGS AND WING-BODY COMBINATIONS IN SUPERSONIC FLOW (AMES-WOODWARD-CARMICHAEL) | L.R. Miranda | - |
| 2801 | COMPUTERIZED AERODYNAMIC FLOW ANALYSIS FOR ARBITRARY BODIES IN SUPERSONIC-HYPERSONIC FLOW | H.H.W. Drosdat | J.F.Holliday |
| 2804 | TWO DIMENSIONAL POTENTIAL FLOW | C.Schwartz | D.Tappeiner |
| 2822 | PROGRAM FOR PREDICTING AERODYNAMIC COEFFICIENTS OF ARBITRARY SLENDER LIFTING REENTRY VEHICLES | S.C.Ghorai | J.F.Holliday |
| 2831 | MODIFIED LIFTING SURFACE THEORY FOR VARIABLE SWEEP PLANFORMS (LAMAR) | L.R.Miranda | D. Kaye |
| 2834 | LANDING PERFORMANCE | R. D.Elliott | T. J. Jones |
| 2837 | THREE DIMENSIONAL POTENTIAL FLOW DIGITAL COMPUTER PROGRAM | C.Schwartz | D.Tappeiner |
| 2855 | FULLY AUTOMATIC COMPUTER TECHNIQUE FOR SIZING (FACTS) | L.M.Kenner | W.J.Harley |
| 2871 | TWO DIMENSIONAL AIRFOIL INVISCID, SUBSONIC PRESSURE DISTRIBUTIONS (VAN DYKE) | W.M. Baker | J. Pryor |
| 2892 | METHODS FOR ANALYSIS OF TWO-DIMENSIONAL AIRFOILS WITH SUBSONIC AND TRANSONIC APPLICATIONS (GELAC) | R.D.Elliott | J. Pryor |
| 2973 | CONSTANT EQUIVALENT AIRSPEED CLIMB GRADIENT | L.J. Aker | T.A. Clark |
| 2977 | SUBSONIC TWIST AND CAMBER-INVERSE LAMAR - - NO OPTIMIZATION | L.J. Aker | D. Kaye |
| 3010 | SINNOTT METHOD FOR COMPUTATION OF SURFACE PRESSURE DISTRIBUTION AND SHOCK PROGRESSION ON WINGS | S.G.Hansen | J. Pece |
| 3082 | COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH PRESSURE GRADIENT AND HEAT TRANSFER (SASMAN & CRESCI) | L.J. Aker | P.Kretsinger |
| 3094 | INDUCED DRAG CALCULATION IN THE SUBSONIC FLOW REGIME | R.H.Shaar | R.McDonald |
| 3111 | MODIFIED LIFTING SURFACE THEORY FOR VARIABLE SWEEP PLANFORMS (LAMAR) | L.R.Miranda | D. Kaye |
| 3112 | MEAN CAMBER LINE DESIGN FOR SWEPT WINGS - KUCHEMANN WEBER | L.R.Miranda | V.LaForrest |
| 3136 | ESTIMATION OF MAXIMUM LIFT OF SWEPT WINGS | R.H.Shaar | R.E.Notestine |

INACTIVE PROGRAMS

| PROGRAM NUMBER | PROGRAM NAME | LAST KNOWN ENGINEER | LAST KNOWN PROGRAMMER |
|---|---|---|---|
| 3152 | GENERATION OF AIRFOIL THICKNESS ORDINATES (GOAT-O) | S.G.Hansen | J. Pryor |
| 3186 | APPROACH FUEL FLOW | K. Young | R.G.Sproul |
| 3307 | TRIM, TAIL LOAD & HINGE MOMENT CALCULATION | D.M. Urie | P.Whittlesey |
| 3329 | F.A.R. TAKEOFF CLIMB LIMIT WEIGHT | E. Bond | R.McDonald |
| 3414 | AERODYNAMIC CHARACTERISTICS OF FAN-IN-WING | L.J.Aker | V.Bollesen |
| 3418 | WHITAM SLENDER BODY THEORY TO CALCULATE INTERFERENCE LIFT & DRAG FROM NACELLES NEAR AN ARBITRARY CAMBER SURFACE | R. Hopps | V.Bollesen |
| 3720 | 6-DEGREE-OF-FREEDOM TIME HISTORY & DYN.MODES | H. V. Button | P.Kretsinger |
| 3920 | NASA-AMES WING-BODY PROGRAM WOODWARD-CARMICHAEL | L.J.Aker | G.Heathcock |
| 4398 | SUPERSONIC WING CAMBER DESIGN | R.D.Elliott | T. J. Jones |
| 4399 | SUPERSONIC NACELLE-WING INTERFERENCE | R.D.Elliott | T. J. Jones |
| 4405 | SUPERSONIC WING CAMBER ANALYSIS | R.D.Elliott | T. J. Jones |

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ABSTRACTS OF AERODYNAMICS DEPARTMENT COMPUTER PROGRAMS

(Revision 2)

**APPROVALS**

x E C B Danforth

DIVISION ENGINEER E. C. B. Danforth

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PRODUCT EVALUATION GROUP

LEGAL BRANCH · PATENT SECTION (STATE ANY RESTRICTIONS)

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Aerodynamics Dept. (75-~~51~~ 41, S&S

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