02999D Program Description I

Program Title PREDICTING THE APPARENT WIND

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PROGRAM DESCRIPTION

The apparent wind is the resultant wind composed of the vectors of the true wind velocity and the yacht's speed. It is the wind felt by the crew on board of a moving yacht wich actuating on the sails develop the aerodinamic forces.

Whenever a change on course takes place, as when rounding a course mark or a navigation land mark, often the new apparent wind direction and/or velocity overhelms even the experienced sailor.

In order to overcame this problem, this program determines the apparent wind velocity and direction on the next course to be sailed in the light of the data from the boat and of the wind on the course being sailed.

To run the program we need to input the following data:

- Vs = boat speed
- C = course being sailed (see ANGLE CONVENTION and WARNINGS)
- β = angle of apparent wind to course being sailed (see ANGLE CONVENTION and WARNINGS)
- Va = apparent wind velocity
- V's = estimate boat speed in the next course
- C' = next course rhumb line

The program gives the following answers:

- V'a = apparent wind velocity in the next course
- β' = angle of apparent wind to rhumb line in the next course

If the above output is incompatible with the estimate boat speed in the next course (V's), the program then will give an easy way to a more accurate solution.

Moreover if β is less than the minimum boat's pointing angle (normally between 25^{o} to 35^{o}) the boat won't be able to sail on the next rhumb line (C'),therefore beating will be mandatory. In such case, input the minimum pointing angle and the corresponding estimated boat speed then the program output the apparent wind speed for said conditions. This program also calculate the true wind velocity and direction.

EQUATIONS

$$\vec{Vt} = \vec{Va} + \vec{Vs}$$

$$\vec{V'a} = \vec{V's} + \vec{Vt}$$

where, Vt = true wind velocity

ANGLE CONVENTION

Courses: they are regarded as normally found in navigation use, i.e. 0º to 360º anti-clockwise.

Angle of apparent wind: if starboard tack 0º to 180º; if port tack 0º to -180º.

Leeway: negative if starboard tack; positive if port tack

WARNINGS

When close hauled or close reaching pay attention to the leeway (λ), which usually varies from 0º to 8º, so:

β = (apparent wind angle given by the wind direction instrument) + (leeway).

02999D Program Description II

EXEMPLE I

V_s = 5 knot C = 60° V_a = 12 knot β = - 50° V'_s = 6 knot C' = 140°

KEYSTROKES

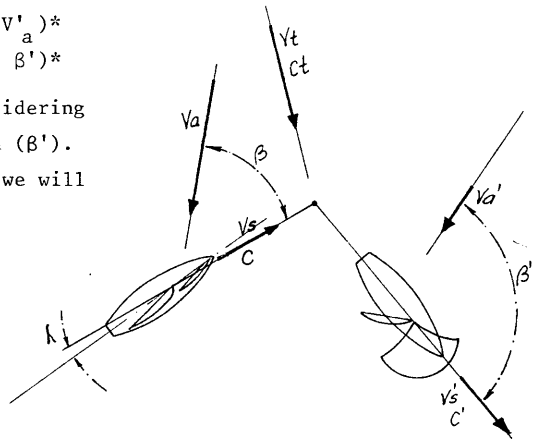
5 [ENTER] 60 [A]
12 [ENTER] 50 [CH] [B]
6 [ENTER] 140 [C] → 4,99 knot (V'_a)*
→ -121,17° (β')*

(*) The boat's speed (V'_s) seems low considering the wind velocity (V'_a) and direction (β'). Bringing the boat speed to 6,5 knot we will have:

6,5 [ENTER] 140 [C] → 4,75 knot (V'_a)
→ -116,00° (β')

The true wind

[E] → 9,58 knot (V_t)
→ 346,45° (C_t)



EXEMPLE II

V_s = 8 knot C = 228,5° V_a = 9 knot β = 175°
V'_s = 8,5 knot C'= 86,5° β min= 29°

KEYSTROKES

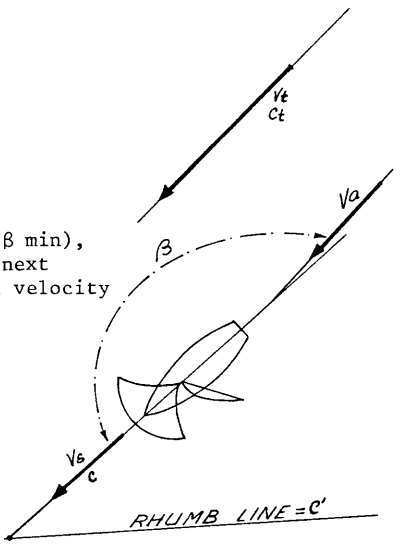
8 [ENTER] 228,5 [A]
9 [ENTER] 175 [B]
8,5 [ENTER] 86,5° [C] → 24,08 knot (V'_a)*
→ -27,35° (β')*

(*) β' is less than the minimum pointing angle (β min), therefore it will be necessary to beat on the next course and in that condition the apparent wind velocity will be:

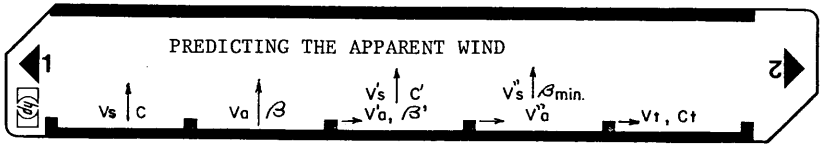
8,5 [ENTER] 29 [D] → 24,76 knot (V''_a)

The true wind

[E] → 16,98 knot (V_t)
→ 45,85° (C_t)



User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load side 1			
2	Select trigonometric mode			
3	Input yacht data	Vs ↑ C	A	
4	Input apparent wind data	Va ↑ β	B	
5	Input next course data	V's ↑ C'	C	V'a
				β'
	NOTE:			
	a) If V's is not compatible with the next course output (V'a, β '), try with new V's, running again step 5			
	b) If β' is smaller than the minimum pointing angle go to step 6			
6	Input close hauled data	V''s ↑βmin	D	V"a
7	To know true wind data		E	Vt
				Ct

Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	f LBL A	31 25 11	Input V_s ↑ C
	f CL REG	31 43	
	STO 1	33 01	
	h x≤ y	35 52	
	f → R	31 72	
	STO - 2	33 51 02	
	h x≤ y	35 52	
	STO - 3	33 51 03	
	h RTN	35 22	
010	f LBL B	31 25 12	Input V_a ↑ β
	RCL 1	34 01	
	+	61	
	h x ≤ y	35 52	
	f → R	31 72	
	STO + 2	33 61 02	
	h x≤ y	35 52	
	STO + 3	33 61 03	
	RCL 2	34 02	
	STO 5	33 05	
020	RCL 3	34 03	
	STO 6	33 06	
	h RTN	35 22	
	f LBLC	31 25 13	Input V'_s ↑ C'
	STO 4	33 04	
	RCL 5	34 05	
	STO 2	33 02	
	CL x	44	
	RCL 6	34 06	
	STO 3	33 03	
030	CL x	44	
	h R↓	35 53	
	h x ≤ y	35 52	
	f→R	31 72	
	STO + 2	33 61 02	
	h x≤ y	35 52	
	STO + 3	33 61 03	
	RCL 3	34 03	
	RCL 2	34 02	
	g → p	32 72	
040	f - x -	31 84	Output V'_a
	h x ≤ y	35 52	
	f x < 0 ?	31 71	
	f GSB Ø	31 22 00	
	RCL 4	34 04	
	-	51	
	1	01	
	8	08	
	Ø	00	
	h x ≤ y	35 52	
050	g x > y ?	32 81	
	GTO 1	22 01	
	h RTN	35 22	Output β'(if β' >0)
	f LBL 1	31 25 01	
	h x ≤ y	35 52	
	2	02	
	X	71	

STEP	KEY ENTRY	KEY CODE	COMMENTS
	-	51	
	h RTN	35 22	Output β'(if β'< 0)
	f LBL D	31 25 14	Input V''_s ↑ β min
060	h x ≤ y	35 52	
	f → R	31 72	
	STO 7	33 07	
	h x ≤ y	35 52	
	STO 8	33 08	
	RCL 6	34 06	
	RCL 5	34 05	
	g → P	32 72	
	STO + 7	33 61 07	
	RCL 8	34 08	
070	RCL 7	34 07	
	g → P	32 72	
	h RTN	35 22	Output V''_a
	f LBL E	31 25 15	
	RCL 6	34 06	
	RCL 5	34 05	
	g → P	32 72	
	f - x -	31 84	Output V_t
	h x ≤ y	35 52	
	f x < Ø ?	31 71	
080	f GSB Ø	31 22 00	
	h RTN	35 22	Output C_t
	f LBL Ø	31 25 00	
	3	03	
	6	06	
	Ø	00	
	+	61	
	RTN	35 22	
090			
100			
110			

REGISTERS

0	1	2	3	4	5	6	7	8	9
	$\mathcal{Y}$	$\Sigma\times$	Σy	$\mathcal{Y}'$	used	used	used	used	
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

02999D

Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
				170			
120							
				180			
130							
				190			
140							
				200			
150							
				210			
160							
				220			

LABELS					FLAGS
A Input	B Input	C In/output	D In/output	E Out/put	0
a	b	c	d	e	1
0 Used	1 Used	2	3	4	2
5	6	7	8	9	3

SET STATUS		
FLAGS	TRIG	DISP
ON OFF 0 ☐ ☒ 1 ☐ ☒ 2 ☐ ☒ 3 ☐ ☒	DEG ☐ GRAD ☐ RAD ☐	FIX ☒ SCI ☐ ENG ☐ n ____