Automated crew for the Felis 747-200

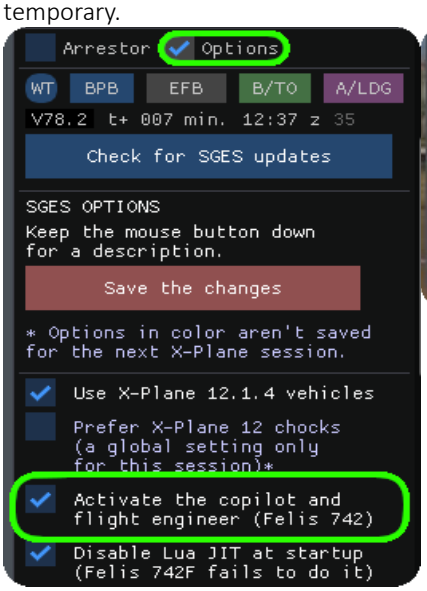
Principle

With this feature included in Simple Ground Equipment and Services, you endorse the role of the Captain and Pilot Flying. The purpose of the plugin is to automate some First Officer and PM actions as well as Flight Engineer actions. You still have to perform manually your dedicated left-hand seat actions during the course of the flight.

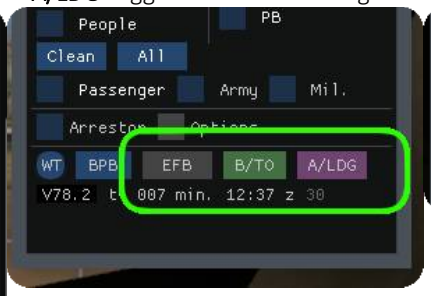
We used the 1992 Evergreen International Airlines Boeing 747-200 Operation Manual to code the content of each procedure.

Interface with the user

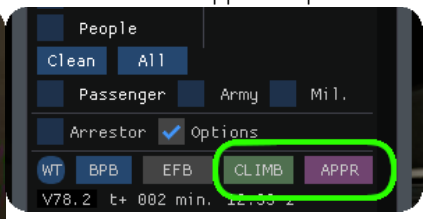
In the SGES menu, click on the options checkbox. You can activate or deactivate the automated copilot. If you click on “Save the changes”, your setting will be remembered for the next flight session. If not, then the activation or the deactivation is only temporary.



On the ground, at the bottom of SGES button several buttons will appear when the copilot is activated.
B/ST starts the before start flow.
B/TO triggers the before takeoff procedure.
A/LDG triggers the after landing one.



In flight, the button **CLIMB** will be present. It triggers the after takeoff procedure.
The button **APPR** triggers the descent and approach procedure.



Procedures and triggers

Not all procedures are scripted. Only a few.

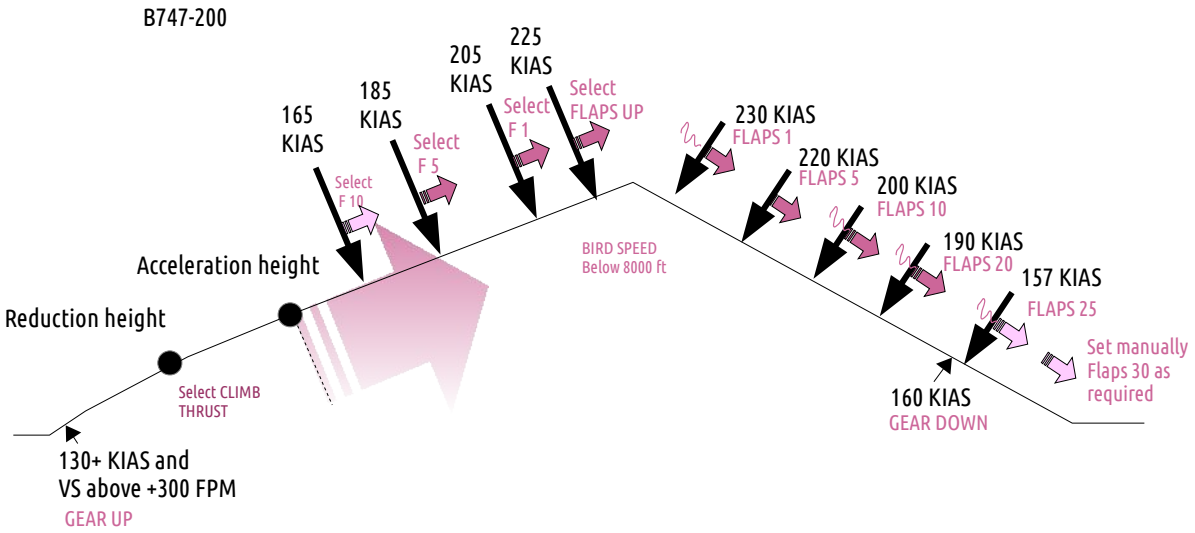
The table shows how to sequence the different procedures.

◊ Before start	Click on the button “B/ST”
◊ Before takeoff	Click on the button “B/TO”
◊ After takeoff and climb	Continued automatically if Before takeoff was active. or Click on the button “CLIMB”
◊ Descent and approach	Initiated automatically below 260 knots IAS and visible descent. (or click on the button “APPR”)
◊ After landing	Continued automatically below a ground speed of 40 knots if Descent and approach was active. or Click on the button “A/LDG”

Flaps schedule

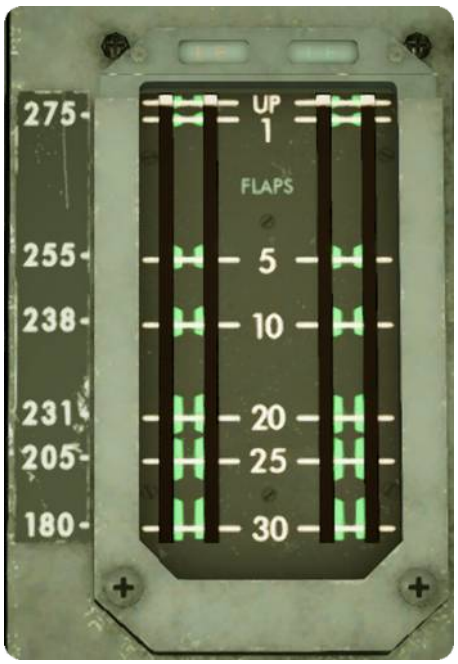
The copilot will trigger flaps and gear during climb and approach procedures. During the approach, simply manage the aircraft speed and attitude. The PNF will naturally **deploy flaps and slats in response to the deceleration**.

The diagram below shows which airspeed we retain to retract or deploy the flaps.



You can safely take over and act manually yourself by anticipation on the flap lever to smooth things as you like it. On the other hand, to **delay flaps extension** you only need to delay speed reduction adequately.

Your automated FO is conservative and you should be always below the $V_{FE\ NEXT}$ at each next stage of flap[1].



$V_{FE\ 1}$ = 275 knots IAS

$V_{FE\ 5}$ = 255 knots IAS

$V_{FE\ 10}$ = 238 knots IAS

$V_{FE\ 20}$ = 231 knots IAS

$V_{FE\ 25}$ = 205 knots IAS

$V_{FE\ 30}$ = 180 knots IAS

1 V_{FE} is the maximum speed with the slats or flaps extended. $V_{FE\ NEXT}$ is the V_{FE} for the next Flaps step.

Before start actions

```
set("B742/OVHD/stall_warn_sw",0)
set("B742/OVHD/radio_master_bus_ESS_on",1)
set("B742/OVHD/radio_master_bus_NO2_on",1)
set("B742/ELEC/standby_power_sw",1)
set("B742/ELEC/ESS_bus_sel",0)
set("B742/ELEC/ESS_bus_sel",1)
set("B742/OVHD/mach_as_warn_test_sw",1)
set("B742/OVHD/mach_as_warn_test_sw",0)
set("B742/OVHD/overrot_test_sw",1)
set("B742/OVHD/stall_warn_sw",-1)
set("B742/OVHD/no_smoking_button",1)
set("B742/OVHD/fasten_belts",1)
set("B742/OVHD/flt_dk_door_rel",1)
set("B742/OVHD/emerg_lights_cap",1)
set("B742/HYD/elec_pump_sys4_cap",1)
set("B742/HYD/elec_pump_sys4_sw",1)
for i=0,3 do set_array("B742/HYD/eng_pump_sw", i, 0) end
for i=1,3 do set_array("B742/HYD/air_pump_sw", i, 0) end-- air driven pumps to OFF
set_array("B742/HYD/air_pump_sw",0,1)
set("B742/APU/APU_start_sw",2)
set("B742/APU/APU_start_sw",1)
set("B742/OVHD/window_heat_sw_2L",1)
set("B742/OVHD/window_heat_sw_2R",1)
set("B742/OVHD/window_heat_sw_1L",1)
set("B742/OVHD/window_heat_sw_1R",1)
set("B742/OVHD/probe_heater_R",1)
set("B742/OVHD/probe_heater_L",1)
if XPLMFindDataRef("B742/FE/AFT_cargo_heat_sw") ~= nil then set("B742/FE/AFT_cargo_heat_sw",1) end
if XPLMFindDataRef("B742/FE/FWD_cargo_heat_sw") ~= nil then set("B742/FE/FWD_cargo_heat_sw",1) end
for i=0,9 do set_array("B742/FUEL/fuel_boost_pump_sw", i, 1) end
set_array("B742/FUEL/fuel_crossfeed_valve_rot",4,0)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",5,0)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",0,1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",3,1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",1,0)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",2,0)
set("B742/radar/mode_sel",1)
set("B742/TCAS/main_mode_sel",1)
set("B742/TCAS/alt_1_off_2",0)-- off
for _,eng in ipairs({0,1,2,3}) do set_array("B742/OVHD/engine_ignition_sys_2", eng, 0)
set("B742/AUX_PWR/APU_GEN1_trip_sw",1)
set("B742/AUX_PWR/APU_GEN2_trip_sw",1)
set("B742/AUX_PWR/APU_GEN1_close_sw",1)
set("B742/APU/APU_bleed_air_sw",1)
set_array("B742/AIR_COND/pack_valves_rotary",0,0)
set_array("B742/AIR_COND/pack_valves_rotary",2,0)
set("B742/AIR_COND/trim_air_sw",0)
for i=0,3 do set_array("B742/AIR_COND/recilc_fan_zones_sw", i, 1) end
for i=0,3 do set_array("B742/AIR_COND/bleed_air_valves", i, 1) end
set_array("B742/FE/galley_pwr_sw",2,0)
set("B742/ext_light/beacon_sw",1)
set("B742/ext_light/NAV_sw",1)
set("B742/ext_light/logo_sw",1)
```

```
if XPLMFindDataRef("B742/OVHD/auto_brake_takeoff_sw") ~= nil then  set("B742/OVHD/auto_brake_takeoff_sw",0)
end
set("B742/OVHD/body_gear_steer_sw",0)
set_array("B742/anim/commanded_pax_doors",0,0)
```

Before take off actions

```
for i=0,9 do set_array("B742/FUEL/fuel_boost_pump_sw", i, 1) end
set_array("B742/FUEL/fuel_crossfeed_valve_rot",4,0)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",5,0)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",0,1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",3,1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",1,0)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",2,0)
set("B742/radar/mode_sel",2)
set("B742/TCAS/main_mode_sel",1)
set("B742/TCAS/alt_1_off_2",-1)
set_array("B742/OVHD/engine_ignition_sys_2", eng, 0)
set_array("B742/OVHD/engine_ignition_sys_1", eng,-1)
set_array("B742/AIR_COND/pack_valves_rotary",0,0)
set_array("B742/AIR_COND/pack_valves_rotary",2,0)
set_array("B742/AIR_COND/pack_valves_rotary",1,0)
set("B742/AIR_COND/trim_air_sw",0)
set_array("B742/FE/galley_pwr_sw",2,0)
set("B742/ext_light/landing_outbd_L_sw",1)
set("B742/ext_light/landing_outbd_R_sw",1)
set("B742/ext_light/landing_inbd_L_sw",1)
set("B742/ext_light/landing_inbd_R_sw",1)
set("B742/ext_light/runway_turnoff_L_sw",1)
set("B742/ext_light/runway_turnoff_R_sw",1)
set("B742/OVHD/auto_brake_takeoff_sw",1)
set("B742/OVHD/body_gear_steer_cap",0)
```

Climb flow

```
set("B742/controls/gear_lever_pos",-1)-- UP
set("sim/flightmodel/controls/flaprqst",0.5)-- FLAPS 10 DEGREES
set("sim/flightmodel/controls/flaprqst",0.33)-- FLAPS 5 DEGREES
set_array("B742/OVHD/engine_ignition_sys_2", eng, 0)
set_array("B742/OVHD/engine_ignition_sys_1", eng, 0)
set("B742/APU/APU_bleed_air_sw",0)
for i=0,3 do set_array("B742/AIR_COND/bleed_air_valves", i, 1) end
set("B742/AIR_COND/mode_sel_rotary",1)
set_array("B742/AIR_COND/pack_valves_rotary",0,1)
set_array("B742/AIR_COND/pack_valves_rotary",2,1)
set_array("B742/AIR_COND/pack_valves_rotary",1,1)
set("B742/AIR_COND/trim_air_sw",1)
set("B742/APU/APU_start_sw",0)
for i=0,3 do set_array("B742/AIR_COND/recilc_fan_zones_sw", i, 1) end
set_array("B742/FE/galley_pwr_sw",2,1)
set("sim/flightmodel/controls/flaprqst",0)-- FLAPS 0 DEGREES
set("B742/ext_light/landing_outbd_L_sw",0)
set("B742/ext_light/landing_outbd_R_sw",0)
```

set("B742/ext_light/landing_inbd_L_sw",0)
set("B742/ext_light/landing_inbd_R_sw",0)
set("B742/ext_light/runway_turnoff_L_sw",0)
set("B742/ext_light/runway_turnoff_R_sw",0)
set("B742/controls/gear_lever_pos",0) – OFF

Descent and approach stream

set("B742/ext_light/landing_outbd_L_sw",1)
set("B742/ext_light/landing_outbd_R_sw",1)
set("B742/ext_light/landing_inbd_L_sw",1)
set("B742/ext_light/landing_inbd_R_sw",1)
set("B742/OVHD/no_smoking_button",1)
set("B742/OVHD/fasten_belts",1)
set("B742/OVHD/flt_dk_door_rel",1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",4,1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",5,1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",0,1)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",3,1)
set_array("B742/OVHD/engine_ignition_sys_2", eng,-1)
set_array("B742/OVHD/engine_ignition_sys_1", eng,-1)
set("sim/flightmodel/controls/flaprqst",0.16)-- FLAPS 1 DEGREES
set("sim/flightmodel/controls/flaprqst",0.33)-- FLAPS 5 DEGREES
set("sim/flightmodel/controls/flaprqst",0.5)-- FLAPS 10 DEGREES
set("sim/flightmodel/controls/flaprqst",0.66)-- FLAPS 20 DEGREES
set("B742/controls/gear_lever_pos",1)-- DOWN
set_array("B742/AIR_COND/pack_valves_rotary",0,1)
set_array("B742/AIR_COND/pack_valves_rotary",2,1)
set("B742/ext_light/runway_turnoff_L_sw",1)
set_array("B742/AIR_COND/pack_valves_rotary",1,1)
set("B742/AIR_COND/trim_air_sw",1)
set("B742/ext_light/runway_turnoff_R_sw",1)
set("B742/APU/APU_start_sw",1)
set("sim/flightmodel/controls/flaprqst",0.83)-- FLAPS 25 DEGREES

After landing items

Please note that the Evergreen International Airlines procedures shows an engine 3 shutdown early after landing. We adopted it.

```
if math.abs(ground_speed) < 40 then
                set("B742/OVHD/body_gear_steer_cap",1)
                set("B742/OVHD/body_gear_steer_sw",0)
end
if math.abs(ground_speed) <= 10 then
                set("sim/flightmodel/controls/flaprqst",0.5)
end
```

set("sim/flightmodel/controls/flaprqst",0.33)
set("B742/OVHD/auto_brake_sel",0)
set("B742/ext_light/landing_outbd_L_sw",0)
set("B742/ext_light/landing_outbd_R_sw",0)
set("B742/ext_light/landing_inbd_R_sw",0)
set("B742/ext_light/runway_turnoff_L_sw",1)

```
set("B742/ext_light/runway_turnoff_R_sw",1)
set("B742/ext_light/logo_sw",1)
set("sim/cockpit2/controls/flap_handle_request_ratio",0)
set("B742/radar/mode_sel",0)
set("B742/TCAS/main_mode_sel",1)
set("B742/TCAS/alt_1_off_2",0)
set("B742/controls/elev_trim_lever_both",0.8)
for _,eng in ipairs({0,1,2,3}) do
                set_array("B742/OVHD/engine_ignition_sys_2", eng, 0)
                set_array("B742/OVHD/engine_ignition_sys_1", eng, 0)
end
set("B742/OVHD/stby_ignition_sel",0)
set("B742/OVHD/window_heat_sw_2L",0)
set("B742/OVHD/window_heat_sw_2R",0)
set("B742/OVHD/window_heat_sw_1L",0)
set("B742/OVHD/window_heat_sw_1R",0)
set("B742/OVHD/probe_heater_R",0)
set("B742/OVHD/probe_heater_L",0)
set("B742/AIR_COND/outflow_valve_sw_L",1)
set("B742/AIR_COND/outflow_valve_sw_R",1)
if XPLMFindDataRef("B742/FE/AFT_cargo_heat_sw") ~= nil then set("B742/FE/AFT_cargo_heat_sw",0) end
if XPLMFindDataRef("B742/FE/FWD_cargo_heat_sw") ~= nil then set("B742/FE/FWD_cargo_heat_sw",0) end
for i=0,9 do set_array("B742/FUEL/fuel_boost_pump_sw", i, 0) end
set_array("B742/FUEL/fuel_crossfeed_valve_rot",4,0)
set_array("B742/FUEL/fuel_crossfeed_valve_rot",5,0)
set("B742/APU/APU_start_sw",2)
set("B742/APU/APU_start_sw",1)
set("B742/AUX_PWR/APU_GEN1_trip_sw",1)
set("B742/AUX_PWR/APU_GEN2_trip_sw",1)
set("B742/AUX_PWR/APU_GEN1_close_sw",1)
set("B742/AUX_PWR/APU_GEN2_close_sw",1)
set("B742/APU/APU_bleed_air_sw",1)
set("B742/ext_light/strobe_sw",0)
set("B742/AIR_COND/outflow_valve_sw_L",0)
set("B742/AIR_COND/outflow_valve_sw_R",0)
set("B742/AUX_PWR/APU_GEN1_trip_sw",0)
set("B742/AUX_PWR/APU_GEN2_trip_sw",0)
set("B742/AUX_PWR/APU_GEN2_close_sw",0)
if Engine 3 N1 < 40 and math.abs(ground_speed) <= 7 then
                set("B742/controls/fuel_cut_off_pos_3",0)
en
set_array("B742/FE/galley_pwr_sw",2,0)
```