Motion and Presence Detection OOB Demo

The Motion and Presence Detection OOB demo shows some of the capabilities of the xWRL6432 SOC using the drivers in the MMWAVE-L-SDK (Software Development Kit). It allows user to specify the chirping profile and displays the detected objects and other information in real-time. The demo comes with two default configurations (PresenceDetect.cfg and MotionDetect.cfg). The configuration in PresenceDetect.cfg leverages the Minor Motion mode of the Signal processing chain to demonstrate the sensors ability to detect presence through fine motion. The MotionDetect.cfg configures the device to detect moving objects. It outputs a point cloud that can be fed to a tracker.

The following documents provide more information on the OOB demo.
[1] describes system execution flow, memory usage, task organization, memory and benchmark results of Motion and Presence detection OOB demo.
[2] contains a high level description of the Signal Processing chain and has useful information on tuning the demo performance for different usecases.

Refer **${SDK_INSTALL_PATH}/docs/MotionPresenceDetectionDemo_documentation.pdf** document for implementation details of Demo application.

Refer **${SDK_INSTALL_PATH}/docs/MotionPresenceDetectionDemo_TuningGuide.pdf** document for Parameter tuning and customization of Demo application.

Supported Combinations

Parameter	Value
CPU + OS	m4fss0-0 freertos
Toolchain	ti-arm-clang
Board	xWRL6432-evm
Example folder	examples/mmw_demo/motion_detection

Steps to Run the Example

- **When using CCS projects to build**, import the CCS project for the required combination and build it using the CCS project menu (see **Using SDK with CCS Projects**).
- **When using makefiles to build**, note the required combination and build using make command (see **Using SDK with Makefiles**)
- Launch a CCS debug session and run the executable, see **CCS Launch, Load and Run**

Configuration (.cfg) File Format (CLI INTERFACE)

> Attention
>
> **Converting configuration from older SDK release to current SDK release:**
> As new versions of SDK releases are available, there are usually changes to the configuration commands that

are supported in the new release. Now, users may have some hand crafted config file which worked perfectly well on older SDK release version but will not work as is with the new SDK release. Check users guide for details.

Note

Example configuration files are available at '${SDK_INSTALL_PATH}/examples/mmw_demo/motion_detection/profiles/xWRL6432-evm'. All the CLI commands should be between 'sensorStop' and 'sensorStart'

Each line in the .cfg file describes a command with parameters. The various commands and their arguments are described in the table below (arguments are in sequence)

Sensor front-end parameters

Commands	Parameters	Notes
sensorStop	FrameStopMode	Indicates the frame stop mode. This command stops the sensor from transmitting further frames. Important Note: This command is not supported when lowPowerCfg is 1
channelCfg	RxChCtrlBitMask	RX antennas 1 and 2, mask = 0x011b = 3 RX antennas 1 and 3, mask = 0x101b = 5 RX antennas 2 and 3, mask = 0x110b = 6 RX antennas 1, 2 & 3, mask = 0x111b = 7
	TxChCtrlBitMask	TX antennas 1 and 2, mask = 0x011b = 3 TX antenna 1, mask = 0x001b = 1 TX antenna 2, mask = 0x010b = 2
	MiscCtrl	Not supported on the current version of the SDK.
chirpComnCfg	DigOutputSampRate	Digital output Sampling rate for chirp ADC samples. Digital sampling rate is given by 100MHz/ DigOutputSampRate. The valid sampling rate can be configured as per below. 8 - 12.5 MHz 9 - 11.11 MHz 10 - 10 MHz 12 - 8.333 MHz 16 - 6.25 MHz 20 - 5 MHz 25 - 4 MHz 32 - 3.125 MHz 40 - 2.5 MHz 50 - 2 MHz 64 - 1.5625 MHz 80 - 1.25 MHz 100 - 1 MHz

	DigOutputBitsSel	Digital output sample bits select, this field governs which bits of the FECSS DFE's internal 16 bit signed data path are sent as output. 0 - Digital sample output is 12 MSB bits of DFE after rounding 4 LSBs 1 - Digital sample output is 12 bits after rounding 3 LSBs & clipping 1 MSB 2 - Digital sample output is 12 bits after rounding 2 LSBs & clipping 2 MSB 3 - Digital sample output is 12 bits after rounding 1 LSBs & clipping 3 MSB 4 - Digital sample output is 12 LSB bits after clipping 4 MSB 5 - Digital sample output is 16 bits
	DfeFirSel	The final stage FIR filter's characteristics can be selected as below. 0 - Long Filter (90% visibility): This provides visibility to a larger range of IF frequencies: 0 to 0.45 x Sampling Rate. Beyond that, the filter response starts drooping & enters filter transition band. 1 - Short Filter (80% visibility): This provides faster settled outputs but the IF frequency range visible is 0 to 0.40 x Sampling Rate. Beyond that, the filter response starts drooping & enters filter transition band.
	NumOfAdcSamples	No. of ADC samples. Current SDK work for values with powers of 2 **Valid Range**: 2 to 2048
	ChirpTxMimoPatSel	Only option 0 is not supported in current OOB Demo. 0 - TX BPM MIMO pattern disabled 1 - TDMA_2TX pattern 4 - BPM_2TX pattern
	ChirpRampEndTime	Chirp Profile Ramp end Time. This is a common ramp end time value for all chirps in a frame.
	ChirpRxHpfSel	Chirp Profile HPF corner frequency. This is a common HPF corner frequency value for all chirps in a frame. 0 - 175kHz HPF corner frequency 1 - 350kHz HPF corner frequency 2 - 700kHz HPF corner frequency 3 - 1400kHz HPF corner frequency
chirpTimingCfg	ChirpIdleTime	Chirp Profile Idle Time. This is a common idle time value for all chirps in a frame. **Unit**: 1us.
	ChirpAdcSkipSamples	Chirp Profile ADC start skip samples. This is a common adc start time value for all chirps in a frame **Valid range**: 0 to 63
	ChirpTxStartTime	Chirp Profile TX start Time. This is a common TX start time value for all chirps in a frame.This field indicates the TX start time in the chirp cycle with respect to the knee of the ramp. **Unit**: In usec

	ChirpRfFreqSlope	Chirp Profile RF Frequency Slope. This is a common RF frequency slope value for all chirps in a frame.This field indicates the required FMCW slope of the chirp. **Unit**: MHz/us **Valid range**:- 399MHz/us to +399MHz/us.
	ChirpRfFreqStart	Chirp Profile RF start Frequency. This is a common RF start frequency value for all chirps in a frame. This field indicates the required start frequency of the chirp. **Unit**: GHz **Valid range**:58GHz to 62.5GHz for ES1.0 devices
frameCfg	NumOfChirpsInBurst	Number of Chirps in a Burst. This field indicates the number of chirps to be generated per burst. **Valid range**: 1 to 65535 chirps . (*Limited support in current OOB*)
	NumOfChirpsAccum	Number of accumulation per chirp. This field indicates the Number of chirps to be accumulated before sending the ADC data out in DFE, this can be used to increase the SNR without increasing the number of chirps to process in the DSP/HW accelerator. **Valid range**: : 0 to 64 chirps. (*Limited support in current OOB*)
	BurstPeriodicity	Burst periodicity in µs. This field indicates the period of the burst. (*Limited support in current OOB*)
	NumOfBurstsInFrame	Number of bursts per frame. **Valid range**:1 to 4096 (*Limited support in current OOB*)
	FramePeriodicity	Frame Periodicity. This field indicates the period of the frame, 32bit counter.This field indicates the frame periodicity, the time gap between successive frame starts. **Unit**: ms **Valid range**:100 to 4294967295 (*Limited support in current OOB*)
	NumOfFrames	Number of frames. **Valid range**: 0 to 65535, 0 means infinite
lowPowerCfg	Enable/Diable	Configuration to enable/disable the power management framework. 0 - Disabled 1 - Enabled
factoryCalibcfg	Save enable	When this option is enabled application will boot-up normally and configure the FECSS to perform all applicable factory calibrations during FECSS initialization. Once the calibrations are performed, application will retrieve the calibration data from FECSS and save it to FLASH. User need to specify valid <flash offset> value. <restore enable> option should be set to 0.

		Note The factory calibration should be done at room temp (25 °C +/- 15 °C) 0 - Save Disabled 1 - Save Enabled
	restore enable	When Restore enabled option is set, application will check the FLASH for a valid calibration data section. If present, it will restore the data from FLASH and provide it to FECSS while configuring it to skip any real-time factory calibrations and use provided calibration data. User need to specify valid <flash offset> value which was used during saving of calibration data. <save enable> option should be set to 0. <rxGain> and <backoff0> arguments will be ignored when restore option is enabled. 0 - Restored Disabled 1 - Restore Enabled
	rxGain	Recommended value is 30db to 40db. **Units**: db.
	backoff0	TX channel power calibration. Valid Range: 0db to 26db. **Units**: db.
	flash offset	Address offset in the flash to be used while saving or restoring calibration data. Make sure the address doesn't overlap the location in FLASH where application images are stored and has enough space for saving factory Calibration data. This field is don't care if both save and restore are disabled.Flash address range is 0x0 to 0x1FFFFF (16Mb) Actual Factory calibration data is of size 128 bytes. It is recommended to use last sector of flash memory starting with address 0x1FF000. **Note** Note The flash offset should be greater than 1MB (0x100000h) for EVM. This check is only to make sure Appimage and ATE calibration data is not corrupted.
baudRate	baudRateVal	The sensor starts with 115200 baud rate by default. When this command is sent to the device, the baud rate for the UART communication is updated according to the given value. Currently only baudRateVal=1250000 is supported
sensorStart	'FrameTrigMode'	Frame Trigger Mode. 0 - Frame SW immediate trigger Mode (SW_TRIG). 1 - Frame SW timer based trigger Mode (SW_TIMER_TRIG). 2 - Frame HW trigger low power Mode (HW_LOW_PWR_TRIG). 3 - Frame HW trigger low jitter Mode (HW_LOW_JIT_TRIG). 4 - CW CZ Trigger Mode (CW_CZ_TRIG). 5 - Chirp Timer Override Trigger Mode (CT_OVRD_TRIG). (*Currently SDK supports only SW_TRIG mode(0)*)
	'ChirpStartSigLbE'	Chirp Timer (CT) start signal loopback enable control. 0 - CHIRP_START_SIGNAL to DIG_SYNC_OUT Loopback Disable

		1 - CHIRP_START_SIGNAL to DIG_SYNC_OUT Loopback Enable. (*Currently SDK supports only Loopback Disable mode(0)*)
	'FrameLivMonEn'	Frame Live monitors enable control. 0 - Live monitor Disabled 1 - Live monitor Enabled (*Currently SDK supports only Live monitor Disabled(0)*)
	'FrameTrigTimerVal'	Frame Trigger Timer Value. 32bit counter value. (*Currently SDK demo is tested only with value 0*)

Detection layer parameters

Commands	Parameters	Notes
sigProcChainCfg	azimuthFftSize	Azimuth FFT size. Suggested to set as power of 2
	elevationFftSize	Elevation FFT size. Suggested to set as power of 2
	motDetMode	Major / Minor / AUTO mode selection 1 - Major motion detection only 2 - Minor motion detection only 3 - Auto detection mode.
	coherentDoppler	Coherent/Non-coherent Doppler selection 0 - Non-coherent integration along Doppler dimension. 1 - Select maximum (coherent) peak in Doppler dimension. 2 - Non-coherent integration along Doppler used to create detection matrix, and find maximum position to add to detected point.
	numFrmPerMinorMotProc	Number of frames included for minor motion detection.
	numMinorMotionChirpsPerFrame	Number of chirps (bursts) per frame used for minor motion detection.
	forceMinorMotionVelocityToZero	Force Doppler value of detected points tp zero in minor motion detection 0 - Disabled 1 - Enabled

	minorMotionVelocityInclusionThr	Minor motion detected points with absolute velocity greater than this threshold are not included in the point cloud list. Threshold is specified in m/sec
cfarCfg	averageMode	CFAR Averaging mode selection Recommened to set 2 0 - CFAR-CA 1 - CFAR-CAGO 2 - CFAR-CASO
	winLen	One-sided noise averaging window length (in samples) of range-CFAR Recommened to set as power of 2
	guardLen	One-sided guard length (in samples) of range-CFAR.
	noiseDiv	Cumulative noise sum divisor expressed as a shift. Sum of noise samples is divided by 2^noiseDiv. Suggested to set as log2(winLen).
	cyclicMode	Cyclic mode or wrapped around mode. 0 - Disabled 1 - Enabled
	thresholdScale	Threshold factor of range-CFAR in dB scale (20log10).
	peakGroupingEn	Enable or disable Peakgrouping 0 - Disabled 1 - Enabled
	sideLobeThreshold	Sidelobe threshold (in linear scale) in azimuth domain to declare a local peak as a valid detection.
	localMaxRangeDomain	Enable/disable selection of the local maximum in the range domain 0 - Disabled 1 - Enabled
	localMaxAzimuthDomain	Enable/disable selection of the local maximum in the Angle domain 0 - Disabled 1 - Enabled
	interpolateRange	Enable /disable the interpolation of the range

		0 - Disabled 1 - Enabled
	interpolateAzimuthDomain	Enable /disable the interpolation of the Azimuth 0 - Disabled 1 - Enabled
aoaFovCfg	minAzimuthDeg	Minimum azimuth angle (in degrees) that specifies the start of field of view
	maxAzimuthDeg	Maximum azimuth angle (in degrees) that specifies the end of field of view
	minElevationDeg	Minimum elevation angle (in degrees) that specifies the start of field of view
	maxElevationDeg	Maximum elevation angle (in degrees) that specifies the end of field of view
rangeSelCfg	minMeters	Minimum range of exported detected points
	maxMeters	Maximum range of exported detected points
clutterRemoval	enabled	Configure the static clutter removal 0 - Disabled 1 - Enabled
compRangeBiasAndRxChanPhase	rangeBias	Value of the Range Bias (m).
	virtAntIdx 1	Phase compensation factor (real, imaginary) of virtual antenna 1.
	virtAntIdx 2	Phase compensation factor (real, imaginary) of virtual antenna 2.
	virtAntIdx 3	Phase compensation factor (real, imaginary) of virtual antenna 3.
	virtAntIdx 4	Phase compensation factor (real, imaginary) of virtual antenna 4.
	virtAntIdx 5	Phase compensation factor (real, imaginary) of virtual antenna 5.
	virtAntIdx 6	Phase compensation factor (real, imaginary) of virtual antenna 6.
measureRangeBiasAndRxChanPhase	enabled	Enable measurement of the range bias and rx channel gain and phase

		imperfections 0 - Disabled 1 - Enabled
	targetDistance	Distance in meters where strong reflector is located to be used as test object for measurement. This field is only used when measurement mode is enabled.
	searchWin	Distance in meters of the search window around targetDistance where the peak will be searched
guiMonitor	pointCloud	Enable/Disable the transmission of the point cloud data 0 - Disable 1 - Enable, point cloud in floating point format, plus side information, 2 - Enable, point cloud in compressed format (fixed point)
	rangeProfile	Enable/Disable the transmission of the Range Profile data 0 - Disable 1 - Enable, range profile from Major mode detection 2 - Enable, range profile from Minor mode detection 3 - Enable, both range profiles
	NoiseProfile	Not used in the current SDK
	rangeAzimuthHeatMap	Enable/Disable transmission of the Range Azimuth heatmap 0 - Disable 1 - Enable, heatmap from Major mode detection 2 - Enable, heatmap from Minor mode detection 3 - Enable, both heatmaps
	rangeDopplerHeatMap	Not used in the current SDK
	statsInfo	Enable/Disable the transmission of the Statistics info that include processing time, temperature, power. (*Partially supported in the current SDK*)

		0 - Disabled 1 - Enabled
	presenceInfo	Enable/Disable the transmission of the presence detection information 0 - Disabled 1 - Enabled
	adcSamples	Enable/Disable the transmission of the raw ADC samplse of the last two chirps of the frame 0 - Disabled 1 - Enabled
	trackerInfo	Enable/Disable the transmission of the group tracker information 0 - Disabled 1 - Enabled
	microDopplerInfo	Enable/Disable the transmission of the micro-Doppler information 0 - Disabled 1 - Enabled
	classifierInfo	Enable/Disable the transmission of the classifier information 0 - Disabled 1 - Enabled
antGeometryCfg	vAnt1_row	row index of virtual antenna 1. (TxAnt1->RxAnt1)
	vAnt1_col	column index of virtual antenna 1. (TxAnt1->RxAnt1)
	vAnt2_row	row index of virtual antenna 2. (TxAnt1->RxAnt2)
	vAnt2_col	column index of virtual antenna 2. (TxAnt1->RxAnt2)
	vAnt3_row	row index of virtual antenna 3. (TxAnt1->RxAnt3)
	vAnt3_col	column index of virtual antenna 3. (TxAnt1->RxAnt3)
	vAnt4_row	row index of virtual antenna 4. (TxAnt2->RxAnt1)
	vAnt4_col	column index of virtual antenna 4. (TxAnt2->RxAnt1)

	vAnt5_row	row index of virtual antenna 5. (TxAnt2->RxAnt2)
	vAnt5_col	column index of virtual antenna 5. (TxAnt2->RxAnt2)
	vAnt6_row	row index of virtual antenna 6. (TxAnt2->RxAnt3)
	vAnt6_col	column index of virtual antenna 6. (TxAnt2->RxAnt3)
	antDistX	Antenna spacing in X dimension in mm. This is optional argument. If omitted, it is assumed that $\lambda/d_x=2$
	antDistZ	Antenna spacing in Z dimension in mm. This is optional argument. If omitted, it is assumed that $\lambda/d_z=2$

Motion/presence detection layer

Commands	Parameters	Notes
mpdBoundaryBox	Zone	Zone: This command is used to describe the boundary of each zone. (*Only four zones are permitted in current SDK*)
	x-min	x-min
	x-max	x-max
	y-min	y-min
	y-max	y-max
	z-min	z-min
	z-max	z-max
sensorPosition	xOffset	Offset of the radar sensor position in x-axis referenced to the boundary box origin. (m)
	yOffset	Offset of the radar sensor position in y-axis referenced to the boundary box origin. (m)
	zOffset	Height of the radar sensor above the ground plane. (m)
	azimTilt	The azimuth tilt (in degrees)of the sensor about the axis Zw. A positive value indicates clockwise rotation when viewing towards the ground.
	elevTilt	The elevation tilt (in degrees)of the sensor about the axis Xw. A positive value indicates tilt towards the ground.
majorStateCfg	pointThre1	Number of detected points (in a single frame) needed in a zone to enter the motion/presence state. If the number of points exceed this threshold, no need to check the SNR.

	pointThre2	Number of detected points (in a single frame) needed in a zone to enter the motion/presence state. If the number of points exceeds this threshold, the snrThre2 criteria is checked.
	snrThre2	Minimum total SNR (linear) of detected points (in a single frame) in a zone to enter the motion/presence state if the pointThre2 criteria is also satisfied.
	pointHistThre1	Number of detected points (in a frame history buffer) needed in a zone to enter the motion/presence state. If the number of points exceed this threshold, no need to check the SNR.
	pointHistThre2	Number of detected points (in a frame history buffer) needed in a zone to enter the motion/presence state. If the number of points exceeds this threshold, the snrHistThre2 criteria is checked.
	snrHistThre2	Minimum total SNR (linear) of detected points (in a frame history buffer) in a zone to enter the motion/presence state if the pointHistThre2 criteria is also satisfied.
	histBufferSize	Size of the frame history buffer size (in frames) used in pointHistThre1, pointHistThre2, and snrHistThre2 parameters.
	major2minorThre	A motion status is preserved if it recorded at least one motion detection in the last major2minorThre frames.
minorStateCfg	pointThre1	Number of detected points (in a single frame) needed in a zone to enter the motion/presence state. If the number of points exceed this threshold, no need to check the SNR.
	pointThre2	Number of detected points (in a single frame) needed in a zone to enter the motion/presence state. If the number of points exceeds this threshold, the snrThre2 criteria is checked.
	snrThre2	Minimum total SNR (linear) of detected points (in a single frame) in a zone to enter the motion/presence state if the pointThre2 criteria is also satisfied.
	pointHistThre1	Number of detected points (in a frame history buffer) needed in a zone to enter the motion/presence state. If the number of points exceed this threshold, no need to check the SNR.
	pointHistThre2	Number of detected points (in a frame history buffer) needed in a zone to enter the motion/presence state. If the number of points exceeds this threshold, the snrHistThre2 criteria is checked.
	snrHistThre2	Minimum total SNR (linear) of detected points (in a frame history buffer) in a zone to enter the motion/presence state if the pointHistThre2 criteria is also satisfied.
	histBufferSize	Size of the frame history buffer size (in frames) used in pointHistThre1, pointHistThre2, and snrHistThre2 parameters.

	minor2emptyThre	A motion status is preserved if it recorded at least one motion detection in the last minor2emptyThre frames.
clusterCfg	enabled	Configure clustering logic. 0: Disable. 1: Enable.
	maxDistance	The radius (in meters) of the neighborhood around a point (i.e., epsilon in DBSCAN algorithm). Note that the distance measure only takes the geometric difference between the point and centroid into account.
	x-max	Minimum number of neighbor points required within the epsilon radius around point.

Tracking layer parameters

Commands	Parameters	Notes
boundaryBox	x-min	Minimum distance in x-dimension with respect to the origin in the World co-ordinates
	x-max	Maximum distance in x-dimension with respect to the origin in the World co-ordinates
	y-min	Minimum distance in y-dimension with respect to the origin in the World co-ordinates
	y-max	Maximum distance in y-dimension with respect to the origin in the World co-ordinates
	z-min	Minimum distance in z-dimension with respect to the origin in the World co-ordinates
	z-max	Maximum distance in z-dimension with respect to the origin in the World co-ordinates Note that Z = 0 corresponds to the ground plane.
staticBoundaryBox	x-min	Minimum distance in x-dimension with respect to the origin in the World co-ordinates
	x-max	Maximum distance in x-dimension with respect to the origin in the World co-ordinates
	y-min	Minimum distance in y-dimension with respect to the origin in the World co-ordinates
	y-max	Maximum distance in y-dimension with respect to the origin in the World co-ordinates
	z-min	Minimum distance in z-dimension with respect to the origin in the World co-ordinates
	z-max	Maximum distance in z-dimension with respect to the origin in the World co-ordinates

		Note that Z = 0 corresponds to the ground plane.
sensorPosition	xOffset	Offset of the radar sensor position in x-axis referenced to the boundary box origin. (m)
	yOffset	Offset of the radar sensor position in y-axis referenced to the boundary box origin. (m)
	zOffset	Height of the radar sensor above the ground plane. (m)
	azimTilt	The azimuth tilt (in degrees)of the sensor about the axis Zw. A positive value indicates clockwise rotation when viewing towards the ground.
	elevTilt	The elevation tilt (in degrees)of the sensor about the axis Xw. A positive value indicates tilt towards the ground.
presenceBoundaryBox	x-min	Minimum distance in x-dimension with respect to the origin in the World co-ordinates
	x-max	Maximum distance in x-dimension with respect to the origin in the World co-ordinates
	y-min	Minimum distance in y-dimension with respect to the origin in the World co-ordinates
	y-max	Maximum distance in y-dimension with respect to the origin in the World co-ordinates
	z-min	Minimum distance in z-dimension with respect to the origin in the World co-ordinates
	z-max	Maximum distance in z-dimension with respect to the origin in the World co-ordinates Note that Z = 0 corresponds to the ground plane.
gatingParam	Gain	Gain of the gating function. It is set based on expected tracking errors and uncertainties of detection layer
	Limit-Width	Gating Limit in Width (m). It is set based on the physical dimensions and agility of the targets
	Limit-Depth	Gating Limit in Depth (m). It is set based on the physical dimensions and agility of the targets
	Limit-Height	Gating Limit in Height (m). It is set based on the physical dimensions and agility of the targets
	Limit-Velocity	Gating Limit in (radial) Velocity (m/s). It is set based on the motion of the targets
allocationParam	snrThre	Minimum total SNR for the allocation set
	snrThreObscured	Minimum total SNR for the allocation set when obscured by another target
	velocityThre	Minimum radial velocity of the allocation set centroid (m/s)

	pointsThre	Minimum number of points in the allocation set
	maxDistanceThre	Maximum squared distance between candidate centroid and centroid to be part of the allocation set (m^2)
	maxVelThre	Maximum velocity difference between candidate and centroid to be part of the allocation set (m/s)
stateParam	det2actThre	In DETECT state; threshold for the number of continuous HIT events to transition from DETECT to ACTIVE state (number of frames)
	det2freeThre	In DETECT state; threshold for the number of continuous MISS events to transition from DETECT to FREE state (number of frames)
	active2freeThre	In ACTIVE state and NORMAL condition; threshold for the number of consecutive MISS events needed to transition from ACTIVE to FREE state (number of frames)
	static2freeThre	In ACTIVE state and STATIC condition; threshold for the number of continuous MISS events for a STATIC target in a static zone to transition from ACTIVE to FREE state (number of frames)
	exit2freeThre	In ACTIVE state and EXIT condition; threshold for the number of continuous MISS events for a target outside the static zone to transition from ACTIVE to FREE state. Determines the Maximum lifespan for the target outside the static box (number of frames)
	sleep2freeThre	Determines the Maximum lifespan for the target inside the static box (number of frames)
maxAcceleration	MaxAccel-X-direction	Maximum amount that the target acceleration is expected to change in the X-direction between time-periods (m/s^2)
	MaxAccel-Y-direction	Maximum amount that the target acceleration is expected to change in the Y-direction between time-periods (m/s^2)
	MaxAccel-Z-direction	Maximum amount that the target acceleration is expected to change in the Z-direction in between time-periods (m/s^2)
trackingCfg	enable	Group tracker processing enable/disable flag: 0 - Disabled 1 - Enabled
	IntialConfigParams	An index to the default internal tracker parameter structure array that initializes the tracker configurations for different use-cases. These internal tracker parameters will be used by default if the user does not set these through the corresponding CLI command

	maxNumPoints	Maximum number of Detection points per frame
	maxNumTracks	Maximum number of Targets to track at any given time
	maxRadialVelocity	Maximum Radial velocity. If the maximum radial velocity reported from the sensor is 5 m/s then maxRadialVelocity needs to be set to 50 (10 x velocity in m/s)
	radialVelocityResolution	Radial velocity resolution in millimeter/sec that the configured chirp profile can provide (mm/sec)
	deltaT	Frame periodicity. This should match the sensor chirp configuration (msec)
	boresightFilteringEnable	Boresight filtering enable/disable flag: 0 - Disabled 1 - Enabled

Classification layer parameters

Commands	Parameters	Notes
microDopplerCfg	enabled	Micro-Doppler (µ-Doppler) and feature extraction processing enable/disable flag: 0 - Disabled 1 - Enabled (*For detailed information refer to Parameter Tuning and Customization Guide*)
	genApproach	The angle spectrum generation approach (in the azimuth domain) when creating the µ-Doppler spectrum per track: 0 - FFT 1 - Beamforming
	targetSize	The target size (in xy-domain) to be used to when extracting the µ-Doppler around the corresponding centroid.
	magnitudeSquared	If this flag is enabled, the generated µ-Doppler spectrum will be magnitude squared: 0: Keep the magnitude spectrum as is. 1: Take the magnitude square (i.e., power spectrum).
	circShiftCentroid	If this flag is enabled, the generated µ-Doppler spectrum will be circularly shifted around the estimated target velocity provided by the tracker: 0: Keep the µ-Doppler spectrum as is. 1: Circularly shift the µ-Doppler spectrum around the estimated target velocity from the tracker.
	normalizedSpectrum	If this flag is enabled, the generated µ-Doppler spectrum will be normalized between [0 1]:

		0: Keep the μ-Doppler spectrum as is. 1: Normalize the μ-Doppler spectrum between [0 1].
	interceptThrLowFreq	The power ratio (%) used to compute the lower envelope (Dlow) feature from the μ-Doppler spectrum. This parameter is common for all the tracked objects.
	interceptThrUpFreq	The power ratio (%) used to compute the upper envelope (Dup) feature from the μ-Doppler spectrum. This parameter is common for all the tracked objects.
	specShiftMode	If this flag is enabled, the generated μ-Doppler spectrum will be circularly shifted around the mean Doppler: 0: Keep the μ-Doppler spectrum as is. 1: Circularly shift the μ-Doppler spectrum around the mean Doppler.
classifierCfg	enabled	Classifier processing enable/disable flag: 0: Disable. 1: Enable.
	minNumPntsPerTrack	Minimum number of points required for a track to run the classifier for it.
	missTotFrmThre	The maximum number of frames allowed which do not have enough number of points for a specific track.

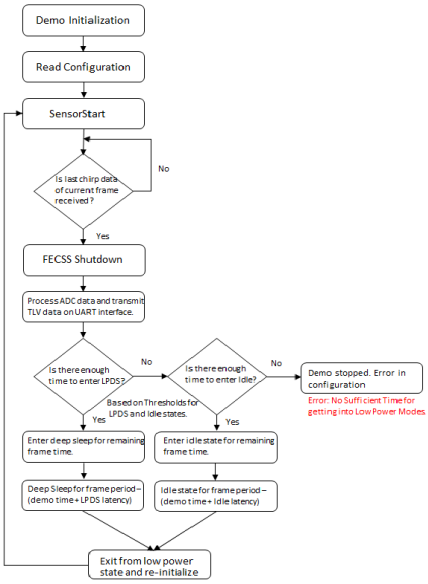
Parameter Tuning Guide

Refer below document to tune the performance of signal processing chain in Motion and Presence detection OOB demo for different use cases and environments.

${SDK_INSTALL_PATH}/docs/MotionPresenceDetectionDemo_TuningGuide.pdf

Flow Diagram in Low Power Configuration (lowPowerCfg = 1)

Below is the high level flow diagram of Motion and Presence detection OOB demo in Low Power Mode:



Flow in Low Power Mode

Power Measurements with INA228

Following are power numbers with SDK default configurations measured using INA228 sensor.

Configuration	Average Power (mW)
High Performance Motion Detection	34.5
Low Power Presence Detection	10.1
Object Tracking	85