



# A121 Smart Presence Reference Application User Guide

User Guide



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Author: Acconeer AB

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## 1 Acconeer SDK Documentation Overview

To better understand what SDK document to use, a summary of the documents are shown in the table below.

Table 1: SDK document overview.

Name	Description	When to use
<b><i>RSS API documentation (html)</i></b>		
rss_api	The complete C API documentation.	- RSS application implementation - Understanding RSS API functions
<b><i>User guides (PDF)</i></b>		
A121 Assembly Test	Describes the Acconeer assembly test functionality.	- Bring-up of HW/SW - Production test implementation
A121 Breathing Reference Application	Describes the functionality of the Breathing Reference Application.	- Working with the Breathing Reference Application
A121 Distance Detector	Describes usage and algorithms of the Distance Detector.	- Working with the Distance Detector
A121 SW Integration	Describes how to implement each integration function needed to use the Acconeer sensor.	- SW implementation of custom HW integration
A121 Presence Detector	Describes usage and algorithms of the Presence Detector.	- Working with the Presence Detector
A121 Smart Presence Reference Application	Describes the functionality of the Smart Presence Reference Application.	- Working with the Smart Presence Reference Application
A121 Sparse IQ Service	Describes usage of the Sparse IQ Service.	- Working with the Sparse IQ Service
A121 Tank Level Reference Application	Describes the functionality of the Tank Level Reference Application.	- Working with the Tank Level Reference Application
A121 STM32CubeIDE	Describes the flow of taking an Acconeer SDK and integrate into STM32CubeIDE.	- Using STM32CubeIDE
A121 Raspberry Pi Software	Describes how to develop for Raspberry Pi.	- Working with Raspberry Pi
A121 Ripple	Describes how to develop for Ripple.	- Working with Ripple on Raspberry Pi
XM125 Software	Describes how to develop for XM125.	- Working with XM125
I2C Distance Detector	Describes the functionality of the I2C Distance Detector Application.	- Working with the I2C Distance Detector Application
I2C Presence Detector	Describes the functionality of the I2C Presence Detector Application.	- Working with the I2C Presence Detector Application
<b><i>Handbook (PDF)</i></b>		
Handbook	Describes different aspects of the Acconeer offer, for example radar principles and how to configure	- To understand the Acconeer sensor - Use case evaluation
<b><i>Readme (txt)</i></b>		
[README	Various target specific information and links	- After SDK download



## 2 Smart presence

Smart presence will divide the presence detection range into multiple zones. The algorithm is based on the presence detector, see [exploration\\_tool-a121-presence\\_detection](#), and has the same configuration possibilities, with the addition to create multiple zones in the detection range.

### 2.1 Detection zones

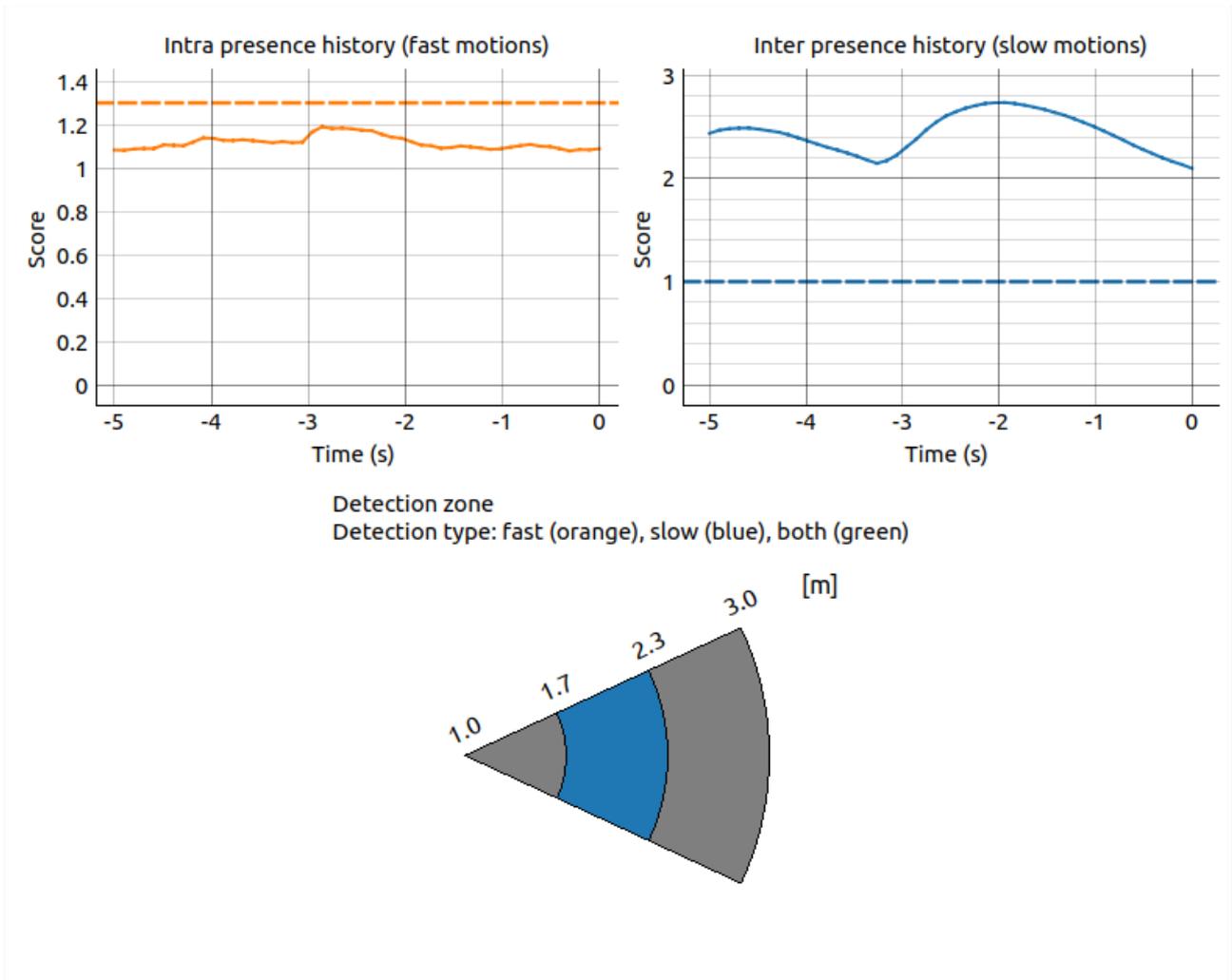
For any chosen range, the range will be divided into the chosen number of detection zones with equal size. The maximum number of detection zones is the number of points in the chosen range. To increase the maximum number of zones without extending the range, the step size can be decreased. This will increase the number of sampling points and thereby increase the power consumption. To get better distance resolution in the zone detections, the chosen profile can be decreased. However, it should be remembered that the chosen profile needs to be large enough to get sufficient SNR in the complete range. Furthermore, the chosen range is the range with optimal energy. Hence, detection can be seen both before the start point and beyond the end point. The amount of extended detection is dependent on the chosen profile and can be estimated to never exceed twice the full width at half maximum envelope power, see [handbook-a121-fom-radial-resolution](#).

### 2.2 Detection types

As for the presence detector, both fast and slow motions are considered. The zone detections can either be used separately for the two detection types or all detected zones, independent of detection type, can be used. For both slow and fast motions, the zone with the highest presence score is returned together with the detection result for all zones. The default for smart presence is to use both fast and slow motion detection to get fast detection, while at the same time having a stable detection when someone is standing still. Since the fast presence detection has lower time constants in the filtering it is more responsive than the slow motion detection, thus the zone detections for fast and slow motions can differ. The *max\_presence\_zone* is the zone with the most presence. However, the fast presence is prioritized due to faster responsiveness, i.e., if fast presence is detected (regardless of if slow presence is detected or not), the zone with highest fast presence score is returned. If only slow presence is detected, the zone with highest slow motion presence score is returned.

### 2.3 GUI

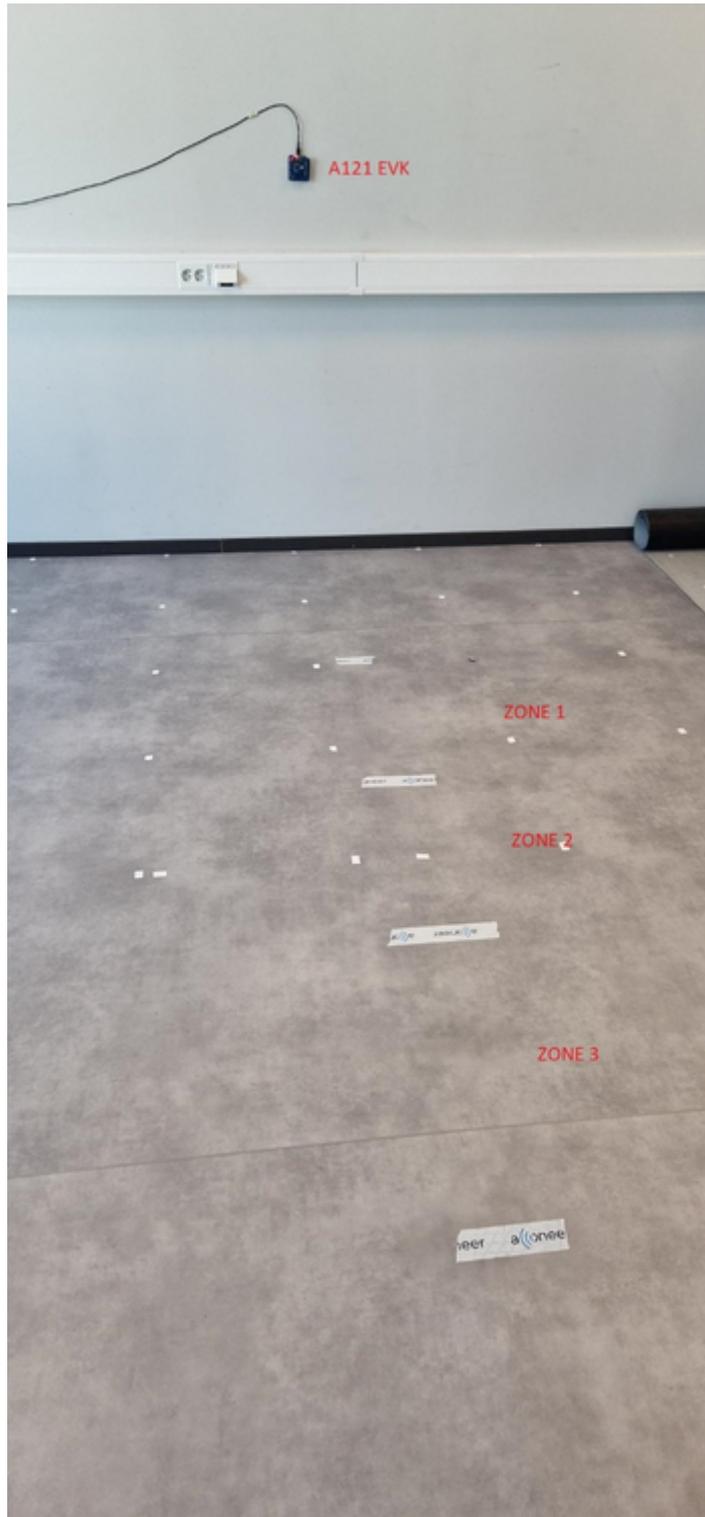
In the GUI, the fast and slow presence score together with their respective threshold is displayed for easy adjustments. The detection zones are displayed in a circle sector with different colors showing detection and detection type. In the circle sector, it is possible to have only the distance with the maximum presence score displayed or to show all detected zones. The example upper plots show that fast motions are not detected, and slow motions are detected. The lower plot displays the range which is set to 1-3 m and that slow motions are detected in the second zone.



## 2.4 Tests

### Test setup

In these tests the A121 EVK was used. The EVK was mounted on a wall at the same height as the test person's torso.





## Test cases

1. Human walking from Zone 3 -> Zone 1 (1-3 meters range)
2. Human walking through all zones from the side (1-3 meters range)
3. Human walking from Zone 3 -> Zone 1 (1-5 meters range)
4. Human walking through all zones from the side (1-5 meters range)

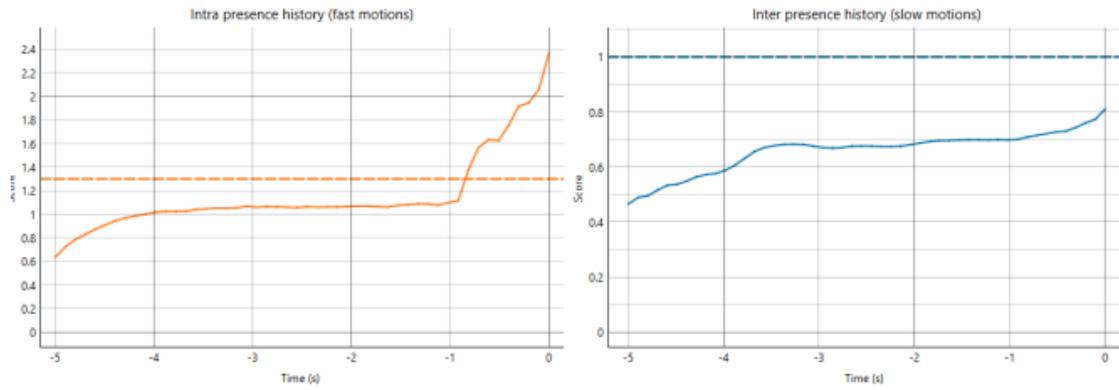
## Configuration

Table 2: Smart presence configuration

Range start	1 m
Range end	3 m / 5 m
Frame rate	10 Hz
Sweeps per frame	32
HWAAS	16
Inter frame idle state	Deep sleep
Enable intra frame detection	True
Intra detection threshold	1.30
Intra time constant	0.15 s
Intra output time constant	0.50 s
Enable inter frame detection	True
Enable phase boost	False
Inter detection threshold	1.0
Inter fast cutoff frequency	20.0 Hz
Inter slow cutoff frequency	0.2 Hz
Inter time constant	0.5 s
Inter output time constant	3.0 s
Inter presence timeout	3 s
Number of zones	3

## Results

1. Human walking from Zone 3 -> Zone 1 (1-3 meters range)



Detection zone  
Detection type: fast (orange), slow (blue), both (green)

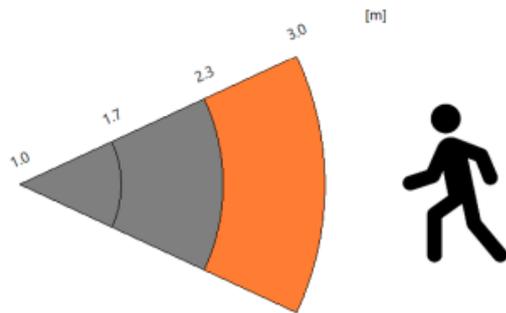




Table 3: Smart presence test results. All zones were detected successfully when walking towards the sensor and each zone was successfully detected when passing by.

Zone	Walk towards	Pass by
0 (1-3 m range)	X	X
1 (1-3 m range)	X	X
2 (1-3 m range)	X	X
0 (1-5 m range)	X	X
1 (1-5 m range)	X	X
2 (1-5 m range)	X	X



### 3 Memory

#### 3.1 Flash

The reference application compiled from `ref_app_smart_presence.c` on the XM125 module requires around 85 kB.

#### 3.2 RAM

The RAM can be divided into three categories, static RAM, heap, and stack. Below is a table for approximate RAM for an application compiled from `ref_app_smart_presence.c`.

RAM	Size (kB)				
	<i>Medium</i>	<i>Short</i>	<i>Long</i>	<i>Ceiling</i>	<i>LP Wakeup</i>
<i>Preset</i>					
Static	1	1	1	1	1
Heap	8	8	7	7	7
Stack	4	4	4	4	4
Total	13	13	12	12	12

### 4 Power Consumption

Average current	Current (mA)				
	<i>Medium</i>	<i>Short</i>	<i>Long</i>	<i>Ceiling</i>	<i>LP Wakeup</i>
<i>Preset</i>					
Nominal	11.4	11.9	69.0	3.7	0.57
Wakeup	0.57	0.32	2.5	1.9	0.13



## 5 Disclaimer

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