Certainly! I can help you with that. Here are the calculations for the conditional probabilities, marginal probabilities, and joint probabilistic data association for the two targets:

**Given:**

* Target 1 position: (10, 20)
* Target 2 position: (25, 15)
* Sensor measurements (replace with actual measurements):
  + Sensor 1: (12, 22)
  + Sensor 2: (23, 17)
* Standard deviations for sensor measurements:
  + σ\_1 = 2
  + σ\_2 = 3

**Calculations:**

1. **Distances:**
   * Distance between target 1 and sensor 1: d\_11 = ||(10, 20) - (12, 22)|| = 2.83
   * Distance between target 1 and sensor 2: d\_12 = ||(10, 20) - (23, 17)|| = 15.81
   * Distance between target 2 and sensor 1: d\_21 = ||(25, 15) - (12, 22)|| = 13.04
   * Distance between target 2 and sensor 2: d\_22 = ||(25, 15) - (23, 17)|| = 2.83
2. **Probability Densities:**
   * p(d\_11 | target 1) = (1 / (2 \* π \* σ\_1^2)) \* exp(-0.5 \* ((d\_11 - mean(d\_11)) / σ\_1)^2) = 0.103
   * p(d\_12 | target 1) = (1 / (2 \* π \* σ\_1^2)) \* exp(-0.5 \* ((d\_12 - mean(d\_12)) / σ\_1)^2) = 0.0002
   * p(d\_21 | target 2) = (1 / (2 \* π \* σ\_2^2)) \* exp(-0.5 \* ((d\_21 - mean(d\_21)) / σ\_2)^2) = 0.049
   * p(d\_22 | target 2) = (1 / (2 \* π \* σ\_2^2)) \* exp(-0.5 \* ((d\_22 - mean(d\_22)) / σ\_2)^2) = 0.103
3. **Conditional Probabilities:**
   * p(target 1 | sensor 1) = p(d\_11 | target 1) / (p(d\_11 | target 1) + p(d\_21 | target 2)) = 0.674
   * p(target 1 | sensor 2) = p(d\_12 | target 1) / (p(d\_12 | target 1) + p(d\_22 | target 2)) = 0.010
   * p(target 2 | sensor 1) = p(d\_21 | target 2) / (p(d\_11 | target 1) + p(d\_21 | target 2)) = 0.326
   * p(target 2 | sensor 2) = p(d\_22 | target 2) / (p(d\_12 | target 1) + p(d\_22 | target 2)) = 0.990
4. **Marginal Probabilities:**
   * p(target 1) = (p(target 1 | sensor 1) + p(target 1 | sensor 2)) / 2 = 0.342
   * p(target 2) = (p(target 2 | sensor 1) + p(target 2 | sensor 2)) / 2 = 0.658
5. **Joint Probabilistic Data Association:**

|  |  |  |
| --- | --- | --- |
| Sensor | Target 1 | Target 2 |
| 1 | p(target 1 | sensor 1) \* p(target 1) = 0.232 |
| 2 | p(target 1 | sensor 2) \* p(target 1) = 0.003 |

**Joint Probabilistic Data Association (JPDA) Calculation with Full Formulas and Tables**

Based on the information provided and assuming equal prior probabilities for both targets, here's the complete JPDA calculation with formulas and tables:

**Given:**

* Target 1 position: (10, 20)
* Target 2 position: (25, 15)
* Sensor measurements:
  + Sensor 1: (12, 22)
  + Sensor 2: (23, 17)
* Standard deviations for sensor measurements:
  + σ\_1 = 2
  + σ\_2 = 3

**Assumptions:**

* Sensor measurements are independent and follow a bivariate normal distribution with zero mean for each individual position (x and y).
* We assume equal prior probabilities for both targets (p(target 1) = p(target 2) = 0.5).

**Steps:**

**1. Calculate Distances:**

|  |  |  |
| --- | --- | --- |
| Target | Sensor | Distance (d\_ij) |
| 1 | 1 | sqrt((12-10)^2 + (22-20)^2) |
| 1 | 2 | sqrt((23-10)^2 + (17-20)^2) |
| 2 | 1 | sqrt((12-25)^2 + (22-15)^2) |
| 2 | 2 | sqrt((23-25)^2 + (17-15)^2) |

**2. Calculate Probability Densities:**

For each measurement (d\_ij) and corresponding sensor standard deviation (σ\_i), use the bivariate normal probability density function formula:

p(d\_ij | target j) = (1 / (2 \* π \* σ\_i^2)) \* exp(-0.5 \* ((d\_ij - mean(d\_ij)) / σ\_i)^2)

**3. Calculate Conditional Probabilities:**

Apply Bayes' theorem for each sensor (i) and target (j):

p(target j | sensor i) = (p(d\_ij | target j) \* p(target j)) / (Σ\_k (p(d\_ik | target k) \* p(target k)))

**4. Calculate Marginal Probabilities:**

Average the conditional probabilities from all sensors for each target (j):

p(target j) = (Σ\_i (p(target j | sensor i))) / number of sensors

**5. Calculate Joint Probabilistic Data Association:**

Create a table with rows representing sensors and columns representing targets. In each cell, calculate the product of the corresponding conditional probability of the target given the sensor and the marginal probability of the target:

p(target j | sensor i) \* p(target j)

**Tables:**

**Distances:**

|  |  |  |
| --- | --- | --- |
| Target | Sensor | Distance (d\_ij) |
| 1 | 1 | 2.83 |
| 1 | 2 | 15.81 |
| 2 | 1 | 13.04 |
| 2 | 2 | 2.83 |

**Probability Densities:**

| Target | Sensor | p(d\_ij | target j) | |---|---|---| | 1 | 1 | 0.103 | | 1 | 2 | 0.0002 | | 2 | 1 | 0.049 | | 2 | 2 | 0.103 |

**Conditional Probabilities:**

| Target | Sensor | p(target j | sensor i) |

|---|---|---|

| 1 | 1 | 0.674 |

| 1 | 2 | 0.010 |

| 2 | 1 | 0.326 |

| 2 | 2 | 0.990 |

**Marginal Probabilities:**

|  |  |
| --- | --- |
| Target | p(target j) |
| 1 | 0.342 |
| 2 | 0.658 |

**Joint Probabilistic Data Association:**

|  |  |  |
| --- | --- | --- |
| Sensor | Target 1 | Target 2 |
| 1 | 0.674 \* 0.342 ≈ 0.232 | 0.326 \* 0.658 ≈ 0.214 |
| 2 | 0.010 \* 0.342 ≈ 0.003 | 0.990 \* 0.658 ≈ 0.6 |
| **Joint Probabilistic Data Association (JPDA) Calculation with Full Formulas and Tables**  Based on the information provided and assuming equal prior probabilities for both targets, here's the complete JPDA calculation with formulas and tables:  **Given:**   * Target 1 position: (10, 20) * Target 2 position: (25, 15) * Sensor measurements:   + Sensor 1: (12, 22)   + Sensor 2: (23, 17) * Standard deviations for sensor measurements:   + σ\_1 = 2   + σ\_2 = 3   **Assumptions:**   * Sensor measurements are independent and follow a bivariate normal distribution with zero mean for each individual position (x and y). * We assume equal prior probabilities for both targets (p(target 1) = p(target 2) = 0.5).   **Steps:**  **1. Calculate Distances:**   |  |  |  | | --- | --- | --- | | Target | Sensor | Distance (d\_ij) | | 1 | 1 | sqrt((12-10)^2 + (22-20)^2) | | 1 | 2 | sqrt((23-10)^2 + (17-20)^2) | | 2 | 1 | sqrt((12-25)^2 + (22-15)^2) | | 2 | 2 | sqrt((23-25)^2 + (17-15)^2) |   **2. Calculate Probability Densities:**  For each measurement (d\_ij) and corresponding sensor standard deviation (σ\_i), use the bivariate normal probability density function formula:  p(d\_ij | target j) = (1 / (2 \* π \* σ\_i^2)) \* exp(-0.5 \* ((d\_ij - mean(d\_ij)) / σ\_i)^2)  **3. Calculate Conditional Probabilities:**  Apply Bayes' theorem for each sensor (i) and target (j):  p(target j | sensor i) = (p(d\_ij | target j) \* p(target j)) / (Σ\_k (p(d\_ik | target k) \* p(target k)))  **4. Calculate Marginal Probabilities:**  Average the conditional probabilities from all sensors for each target (j):  p(target j) = (Σ\_i (p(target j | sensor i))) / number of sensors  **5. Calculate Joint Probabilistic Data Association:**  Create a table with rows representing sensors and columns representing targets. In each cell, calculate the product of the corresponding conditional probability of the target given the sensor and the marginal probability of the target:  p(target j | sensor i) \* p(target j)  **Tables:**  **Distances:**   |  |  |  | | --- | --- | --- | | Target | Sensor | Distance (d\_ij) | | 1 | 1 | 2.83 | | 1 | 2 | 15.81 | | 2 | 1 | 13.04 | | 2 | 2 | 2.83 |   **Probability Densities:**  | Target | Sensor | p(d\_ij | target j) | |---|---|---| | 1 | 1 | 0.103 | | 1 | 2 | 0.0002 | | 2 | 1 | 0.049 | | 2 | 2 | 0.103 |  **Conditional Probabilities:**  | Target | Sensor | p(target j | sensor i) | |---|---|---| | 1 | 1 | 0.674 | | 1 | 2 | 0.010 | | 2 | 1 | 0.326 | | 2 | 2 | 0.990 |  **Marginal Probabilities:**   |  |  | | --- | --- | | Target | p(target j) | | 1 | 0.342 | | 2 | 0.658 |   **Joint Probabilistic Data Association:**   |  |  |  | | --- | --- | --- | | Sensor | Target 1 | Target 2 | | 1 | 0.674 \* 0.342 ≈ 0.232 | 0.326 \* 0.658 ≈ 0.214 | | 2 | 0.010 \* 0.342 ≈ 0.003 | 0.990 \* 0.658 ≈ 0.6 |   **Joint Probabilistic Data Association (JPDA) Calculation with Full Formulas and Tables**  Based on the information provided and assuming equal prior probabilities for both targets, here's the complete JPDA calculation with formulas and tables:  **Given:**   * Target 1 position: (10, 20) * Target 2 position: (25, 15) * Sensor measurements:   + Sensor 1: (12, 22)   + Sensor 2: (23, 17) * Standard deviations for sensor measurements:   + σ\_1 = 2   + σ\_2 = 3   **Assumptions:**   * Sensor measurements are independent and follow a bivariate normal distribution with zero mean for each individual position (x and y). * We assume equal prior probabilities for both targets (p(target 1) = p(target 2) = 0.5).   **Steps:**  **1. Calculate Distances:**   |  |  |  | | --- | --- | --- | | Target | Sensor | Distance (d\_ij) | | 1 | 1 | sqrt((12-10)^2 + (22-20)^2) | | 1 | 2 | sqrt((23-10)^2 + (17-20)^2) | | 2 | 1 | sqrt((12-25)^2 + (22-15)^2) | | 2 | 2 | sqrt((23-25)^2 + (17-15)^2) |   **2. Calculate Probability Densities:**  For each measurement (d\_ij) and corresponding sensor standard deviation (σ\_i), use the bivariate normal probability density function formula:  p(d\_ij | target j) = (1 / (2 \* π \* σ\_i^2)) \* exp(-0.5 \* ((d\_ij - mean(d\_ij)) / σ\_i)^2)  **3. Calculate Conditional Probabilities:**  Apply Bayes' theorem for each sensor (i) and target (j):  p(target j | sensor i) = (p(d\_ij | target j) \* p(target j)) / (Σ\_k (p(d\_ik | target k) \* p(target k)))  **4. Calculate Marginal Probabilities:**  Average the conditional probabilities from all sensors for each target (j):  p(target j) = (Σ\_i (p(target j | sensor i))) / number of sensors  **5. Calculate Joint Probabilistic Data Association:**  Create a table with rows representing sensors and columns representing targets. In each cell, calculate the product of the corresponding conditional probability of the target given the sensor and the marginal probability of the target:  p(target j | sensor i) \* p(target j)  **Tables:**  **Distances:**   |  |  |  | | --- | --- | --- | | Target | Sensor | Distance (d\_ij) | | 1 | 1 | 2.83 | | 1 | 2 | 15.81 | | 2 | 1 | 13.04 | | 2 | 2 | 2.83 |   **Probability Densities:**  | Target | Sensor | p(d\_ij | target j) | |---|---|---| | 1 | 1 | 0.103 | | 1 | 2 | 0.0002 | | 2 | 1 | 0.049 | | 2 | 2 | 0.103 |  **Conditional Probabilities:**  | Target | Sensor | p(target j | sensor i) | |---|---|---| | 1 | 1 | 0.674 | | 1 | 2 | 0.010 | | 2 | 1 | 0.326 | | 2 | 2 | 0.990 |  **Marginal Probabilities:**   |  |  | | --- | --- | | Target | p(target j) | | 1 | 0.342 | | 2 | 0.658 |   **Joint Probabilistic Data Association:**   |  |  |  | | --- | --- | --- | | Sensor | Target 1 | Target 2 | | 1 | 0.674 \* 0.342 ≈ 0.232 | 0.326 \* 0.658 ≈ 0.214 | | 2 | 0.010 \* 0.342 ≈ 0.003 | 0.990 \* 0.658 ≈ 0.6 |   @@@  Let's go through the steps to calculate Joint Probabilistic Data Association (JPDA) with full formulas and tables.  ### Step 1: Calculate Distances  We calculate the Euclidean distances between each sensor measurement and each target position.  | Target | Sensor | Distance (d\_ij) |  |--------|--------|-----------------|  | 1 | 1 | 2.83 |  | 1 | 2 | 15.81 |  | 2 | 1 | 13.04 |  | 2 | 2 | 2.83 |  ### Step 2: Calculate Probability Densities  We use the bivariate normal probability density function formula:  \[ p(d\_{ij} | \text{target } j) = \frac{1}{2\pi \sigma\_i^2} e^{-\frac{(d\_{ij} - \text{mean}(d\_{ij}))^2}{2\sigma\_i^2}} \]  Where \( \sigma\_i \) is the standard deviation for sensor \( i \).  ### Step 3: Calculate Conditional Probabilities  Apply Bayes' theorem for each sensor (i) and target (j):  \[ p(\text{target } j | \text{sensor } i) = \frac{p(d\_{ij} | \text{target } j) \times p(\text{target } j)}{\sum\_{k} (p(d\_{ik} | \text{target } k) \times p(\text{target } k))} \]  ### Step 4: Calculate Marginal Probabilities  Average the conditional probabilities from all sensors for each target (j):  \[ p(\text{target } j) = \frac{\sum\_{i} (p(\text{target } j | \text{sensor } i))}{\text{number of sensors}} \]  ### Step 5: Calculate Joint Probabilistic Data Association  Create a table with rows representing sensors and columns representing targets. In each cell, calculate the product of the corresponding conditional probability of the target given the sensor and the marginal probability of the target:  \[ p(\text{target } j | \text{sensor } i) \times p(\text{target } j) \]  Here are the calculations and tables:  \*\*Probability Densities:\*\*  | Target | Sensor | \( p(d\_{ij} | \text{target } j) \) |  |--------|--------|-----------------------------------|  | 1 | 1 | 0.103 |  | 1 | 2 | 0.0002 |  | 2 | 1 | 0.049 |  | 2 | 2 | 0.103 |  \*\*Conditional Probabilities:\*\*  | Target | Sensor | \( p(\text{target } j | \text{sensor } i) \) |  |--------|--------|--------------------------------------------|  | 1 | 1 | 0.674 |  | 1 | 2 | 0.010 |  | 2 | 1 | 0.326 |  | 2 | 2 | 0.990 |  \*\*Marginal Probabilities:\*\*  | Target | \( p(\text{target } j) \) |  |--------|--------------------------|  | 1 | 0.342 |  | 2 | 0.658 |  \*\*Joint Probabilistic Data Association:\*\*  | Sensor | Target 1 | Target 2 |  |--------|----------|----------|  | 1 | 0.674 \* 0.342 ≈ 0.232 | 0.326 \* 0.658 ≈ 0.214 |  | 2 | 0.010 \* 0.342 ≈ 0.003 | 0.990 \* 0.658 ≈ 0.651 |  These values represent the likelihood of each measurement being associated with each target. |  |  |