Infinite Factorial Dynamical Model

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Motivation
Motivation

Bayesian Nonparametrics

Infinite Factorial Dynamical Model

Multi-target tracking

Cocktail party

Power disaggregation

Multi-user detection

Sources with continuous states

Sources with discrete states

- Multi-target tracking
- Cocktail party
- Power disaggregation
- Multi-user detection

Additive noise

\[ \text{Source 1} \quad + \quad \text{Source 2} \quad = \quad \text{Mixture} \quad \rightarrow \quad \text{Source Separation} \quad ? \]

Table 3: Results for the multiuser detection problem.

<table>
<thead>
<tr>
<th>Method</th>
<th>Multiuser Communication System</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFBS</td>
<td>Average position error.</td>
</tr>
<tr>
<td>PGAS</td>
<td></td>
</tr>
</tbody>
</table>

Model complexity grows with data size.
Motivation

Internet of Things.

• Discrete signals (messages).
• Transmitters enter & leave the system.
• Receiver needs to infer #sources.
Contributions

Infinite Factorial Dynamical Model

1. A general Bayesian non parametric model for source separation.
   - Infers #sources from data.
   - Valid for a wide range of applications.
2. Efficient inference.
   - Valid for many likelihood and dynamical models.
3. Comprehensive set of experiments.
Contributions

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Multipath propagation
**Model and Inference**

1. **Model**
   - Infinite parallel chains (based on Markov IBP).
   - Finite number of active sources for any finite dataset.

2. **Inference**
   - Infers active sources, their states, and other parameters.
   - Slice sampling & Particle Gibbs with ancestor sampling.

```
\begin{align*}
\alpha &\rightarrow q^m \\
\beta_0, \beta_1 &\rightarrow b^m \\
\end{align*}
```

Can accommodate:
- Any transition probabilities $p(x_{tm}|x_{(t-1)m}, s_{(t-1)m}, x_{tm})$.
- Any likelihood $p(y_t|\{x_{tm}, x_{(t-1)m}, \ldots, x_{(t-L+1)m}\}^M_{m=1})$. 

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**Experiments**

Experiments on 4 applications:

- Multi-target tracking.
- Cocktail party.
- Power disaggregation.
- Multi-user detection.

Wi-Fi system at Bell Labs Crawford Hill