A Recommendation Method for Garage Parking

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Goals, Motivations, Challenges
Background & Related Research

Cruising for parking:

› Approx. 30% of all traffic in inner cities¹
› Avg. 8 minutes to find parking¹
Background & Related Research

Cruising for parking:
› Approx. 30% of all traffic in inner cities\(^1\)
› Avg. 8 minutes to find parking\(^1\)

Parking information systems:
› Several systems available: SFPark\(^2\), ParkMe\(^3\), ParkingPanda\(^4\), ParkMate\(^5\), ...
› Have smart-phone app as major component
› Main weaknesses:
  › Assume high adoption rate
  › Assume special electronic sensor systems in/at each parking spot
Our Approach: Goals and Pre-requisites

**Goals:**

› Recommend best available parking in controlled access garages
› No sensors at individual spots
› No assumption of high adoption
Our Approach: Goals and Pre-requisites

Goals:
› Recommend best available parking in controlled access garages
› No sensors at individual spots
› No assumption of high adoption

Pre-requisites:
› Data collection:
  › Camera/license plate reader at entry and exit lanes
  › Optional data from CCTV, mobile license plate readers, additional counters, etc.
› Recommendation:
  › Computer screen at entry lanes
  › Smart-phone app (or embedded front-end module)
Our Approach: How Do Garages Fill Up?

\[ c(a_{i1}) \geq c(a_{i2}) \geq \ldots \geq c(a_{in}) \]
Our Approach: Basic Method

Car is registered in entry lane\textsuperscript{6,7}:

› Can driver be reached (by screen or smart-phone app)?
› A. Yes – “Park in the most attractive area with ratio of $\frac{\text{estimated number of occupied spots}}{\text{total number of spots}} \leq h$!”
Our Approach: Basic Method

Car is registered in entry lane⁶,⁷:

› Can driver be reached (by screen or smart-phone app)?
› A. Yes – “Park in the most attractive area with ratio of \( \frac{\text{estimated number of occupied spots}}{\text{total number of spots}} \leq h \)!”
› Does driver follow recommendation (probability \( 0 \leq p \leq 1 \))?  
› A.1. Yes – Increase number of cars in recommended area
Our Approach: Basic Method

Car is registered in entry lane⁶,⁷:

› Can driver be reached (by screen or smart-phone app)?
  › A. Yes – “Park in the most attractive area with ratio of \( \frac{\text{estimated number of occupied spots}}{\text{total number of spots}} \leq h \)."

  › Does driver follow recommendation (probability \( 0 \leq p_f \leq 1 \))?
    › A.1. Yes – Increase number of cars in recommended area
    › A.2. No – Two options (\( 0 \leq p_c \leq 1 \)):
      › A.2.A – Driver does not trust or understand system and starts cruising
      › A.2.B – Driver’s order of attractiveness diverges widely from assumed order
        → Driver simply does not want to park at the recommended area
Our Approach: Basic Method

Car is registered in entry lane\textsuperscript{6,7}:

\begin{itemize}
    \item Can driver be reached (by screen or smart-phone app)?
    \item A. Yes – “Park in the most attractive area with ratio of \( \frac{\text{estimated number of occupied spots}}{\text{total number of spots}} \leq h \)!”
    \item Does driver follow recommendation (probability \( 0 \leq p_f \leq 1 \))?
        \begin{itemize}
            \item A.1. Yes – Increase number of cars in recommended area
            \item A.2. No – Two options (\( 0 \leq p_c \leq 1 \)):
                \begin{itemize}
                    \item A.2.A – Driver does not trust or understand system and starts cruising
                    \item A.2.B – Driver’s order of attractiveness diverges widely from assumed order
                        \rightarrow Driver simply does not want to park at the recommended area
                \end{itemize}
        \end{itemize}
    \item B. No – Similar procedure as in A.2
\end{itemize}
Our Approach: Basic Method

Car is registered in entry lane\textsuperscript{6,7}:

\begin{itemize}
  \item Can driver be reached (by screen or smart-phone app)?
  \item A. Yes – "Park in the most attractive area with ratio of \( \frac{\text{estimated number of occupied spots}}{\text{total number of spots}} \leq h \) !"
    \begin{itemize}
      \item Does driver follow recommendation (probability \( 0 \leq p_f \leq 1 \))?
        \begin{itemize}
          \item A.1. Yes – Increase number of cars in recommended area
          \item A.2. No – Two options (\( 0 < p_c \leq 1 \)):
            \begin{itemize}
              \item A.2.A – Driver does not trust or understand system and starts cruising
              \item A.2.B – Driver’s order of attractiveness diverges widely from assumed order
                \( \rightarrow \) Driver simply does not want to park at the recommended area
            \end{itemize}
        \end{itemize}
    \end{itemize}
  \item B. No – Similar procedure as in A.2
\end{itemize}

Car is registered in exit lane\textsuperscript{6,7}:

\begin{itemize}
  \item Car is discharged from estimated parking position
  \item Estimated number of occupied spots in that area is decreased
\end{itemize}
Our Approach: What will it look like?

Smartphone app
Real-time and predictive parking recommendations
Summary

- Searching for parking a major waste of time
- Proposed research: Recommend best available parking in controlled access parking garages
  - Via smart-phone app or computer screen
  - Not an exact method, stochastic model
- Competitive advantages:
  - No sensors at each parking spot
  - Beneficial from first user on
Milestones & Deliverables:
› Core research – 6 months
› Demonstration – 3 months
› Report/paper – 3 months

Budget:
› Faculty time – $20,000
› Student time – $25,000
› Equipment, supplies, travel – $5,000
› Total: $50,000
END – THANK YOU
References


