MODELLING ACCIDENT RISK AND CROSSING BEHAVIOR OF PEDESTRIANS

HEARTS

WP7 - Development and testing of Road Accident Model

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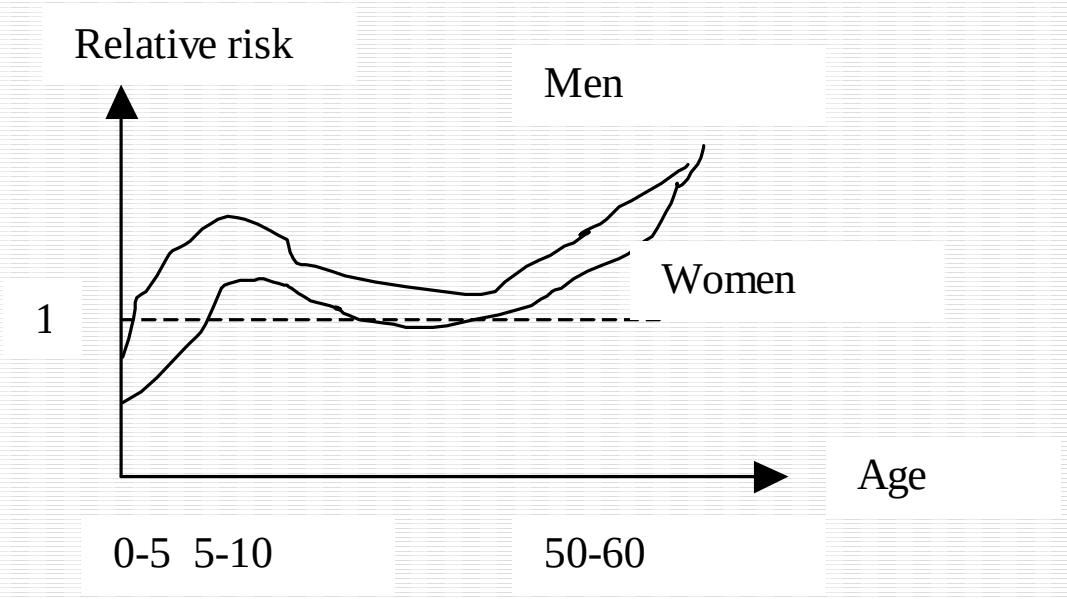
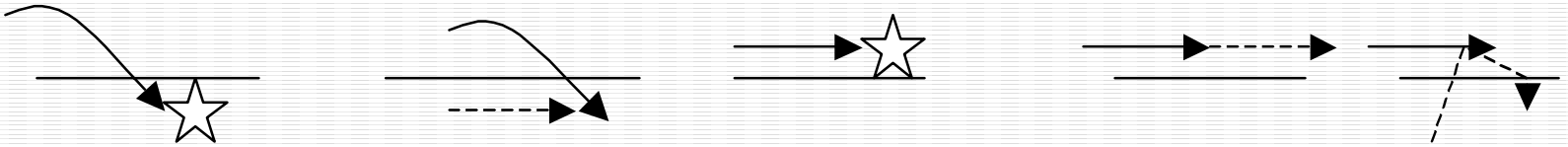
Introduction



Hypothesis: the pedestrian is at risk only when crossing the street at midblock or junction



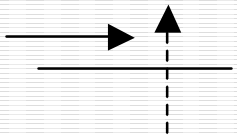
standing pavement

walking pavement

standing street

walking street

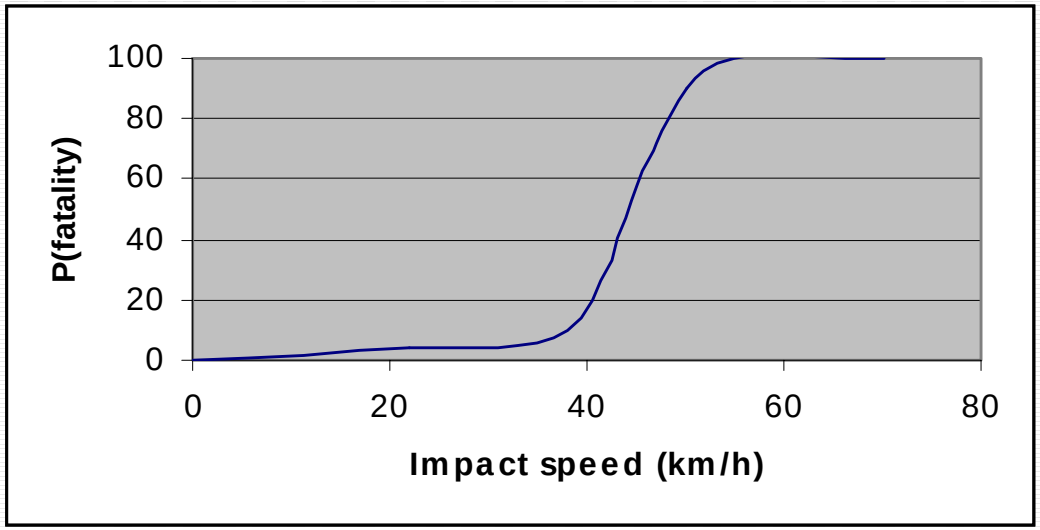
acting pavement /street



crossing

Exposure=(time,concentration,speed)

- Time to cross = lane width/pedestrian speed
- « Concentration » = presence of cars when crossing
- Impact speed in collision



Assessment of concentration (1 / 5)

(Routledge, 1974)

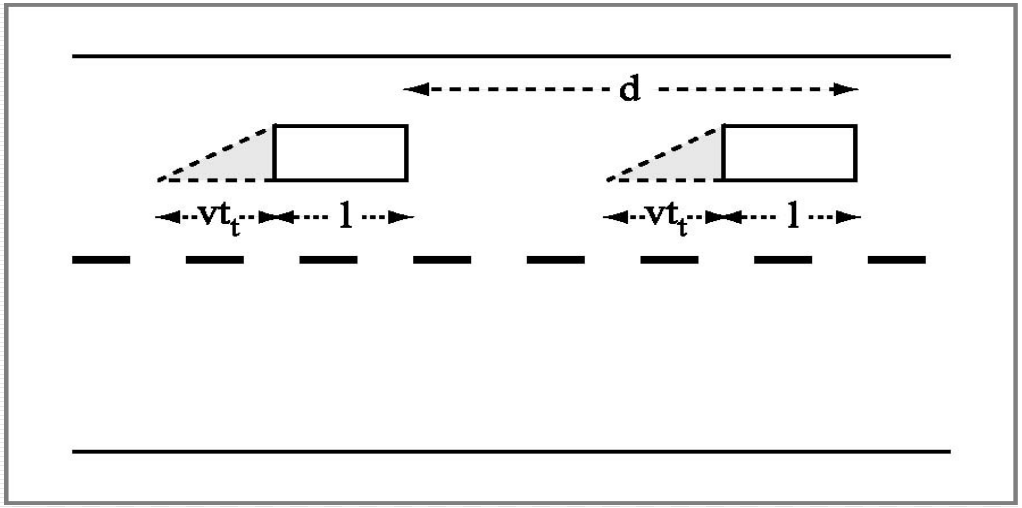
$$P = \frac{l + vt_c}{d}$$

l equal to the average length of the vehicle

v the average speed of the flow

d the average gap between vehicle in the flow

t_c the average crossing time for a pedestrian



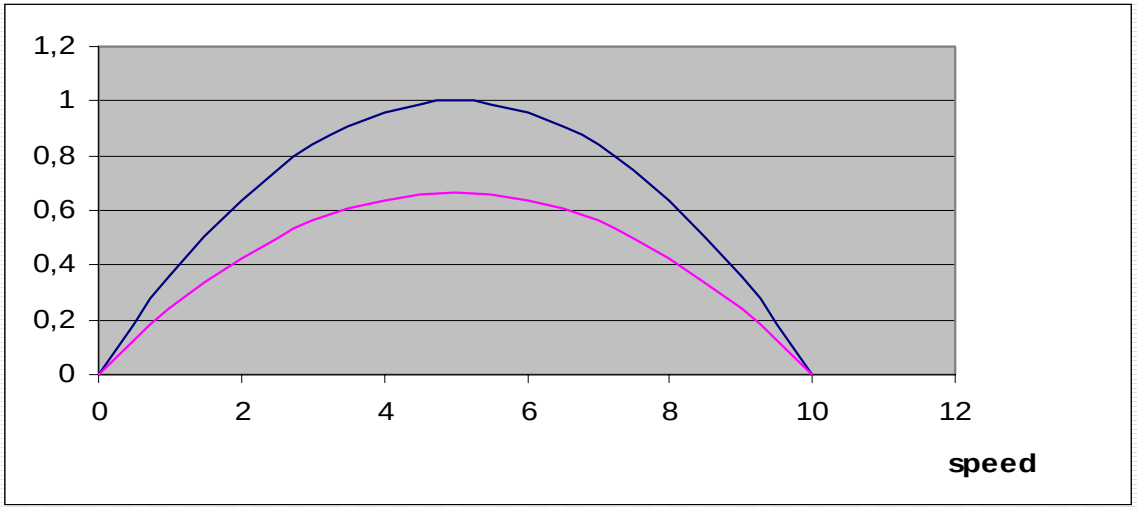
Assessment of concentration (2/5)

- Only the mobile part

$$P = k\, t_c v$$

$$= k_J \left(1 - \frac{v}{v_f}\right) t_c v$$

$$= t_c q$$



indicator function of speed (m/s) with vf= 10 m/s, l = 5 m., tc = 3 s. and 2 s with a linear function speed/concentration.

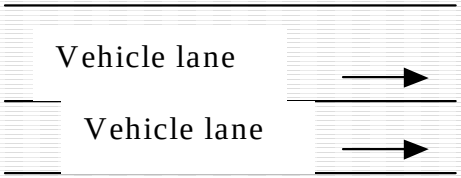
Assessment of concentration (3 / 5)

- **Midblocks**

$$t_c = \frac{L}{v_c}$$

$$t_c q$$

$$v$$



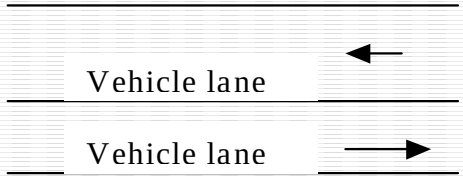
$$t_{c1} = \frac{L}{2v_c}, t_{c1} q_1, v_1$$

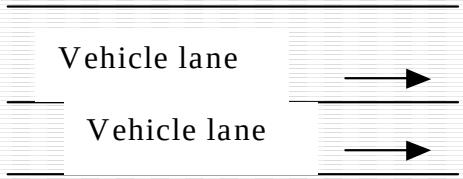
$$t_{c2} = \frac{L}{2v_c}, (t_{c1} + t_{c2}) q_2, v_2$$

$$P = 1 - ((1 - P_1)(1 - P_2))$$

$$t_c = t_{c1} + t_{c2}$$

=





Assessment of concentration (4 / 5)

- Zebra crossings and median

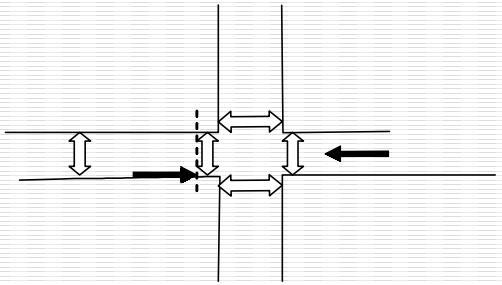
$$t_{c1} = \frac{L}{2v_c}, t_{c1}q_1, \varphi(v_1)$$

$$t_{c2} = \frac{L}{2v_c}, t_{c2}q_2, \varphi(v_2)$$

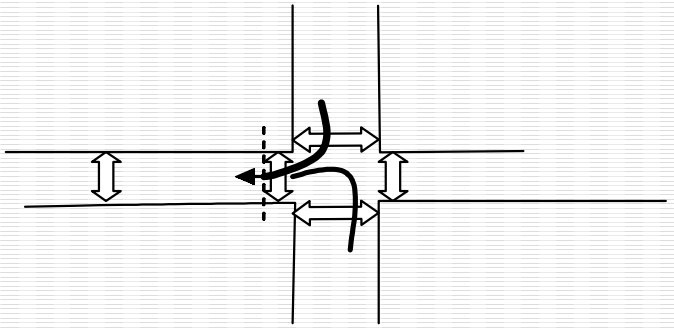
Assessment of concentration (5 / 5)

- **Junctions**

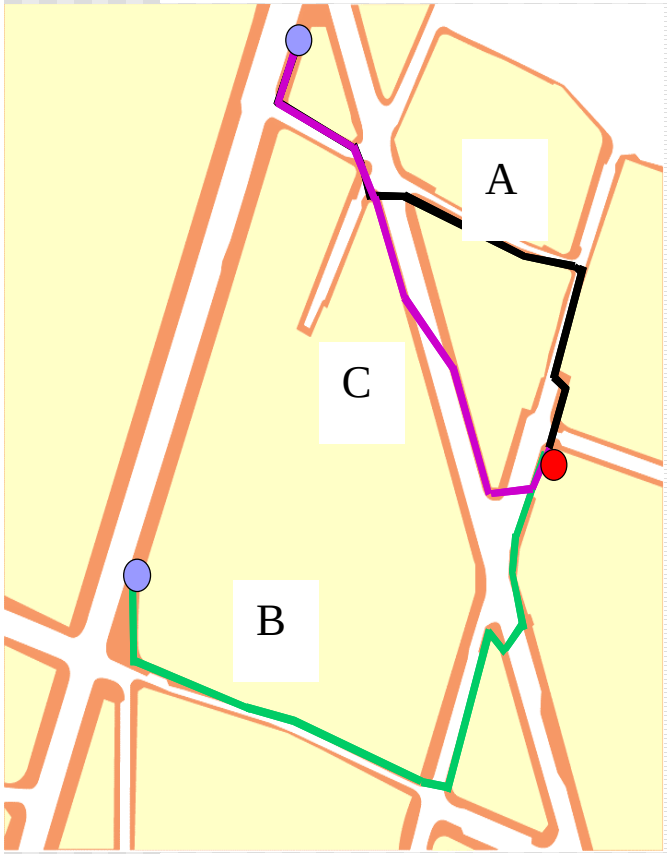
Red for pedestrian



Green for pedestrian
- running lights
- turning movements



Estimation of accident exposure



Trip	direction	flow	concentration	speed	time	zebra/ligth
A	ssac11	1	0,578703704	40	4,17	zebrunninggreen
A	ssac12	1	1,157407407	45	4,17	zebrunninggreen
A	acques1	1	0,972222222	35	5,83	zebra
B	acques2	1	0,648148148	40	5,83	zebrunninggreen
B	ssac21	1	0,462962963	40	4,17	zebrunninggreen
B	ssac22	1	0,925925926	40	4,17	zebrunninggreen
B	ssac21	1	0,092592593	20	4,17	zebraturning
C	ssac11	1	0,578703704	40	4,17	nozebra
C	ssac12	1	1,157407407	45	4,17	nozebra
C	acques1	1	0,972222222	35	5,83	zebra

Calibration and validation

- Exposure

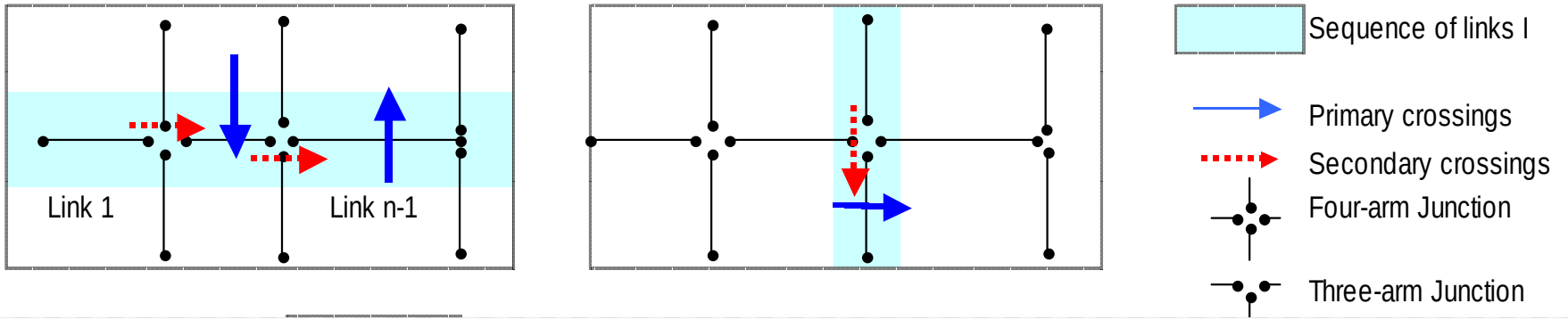
- Distribution of the number of crossings
- Distribution of the places of crossings (beginning/end)
- Distribution of the traffic flows and speeds by lane related to crossings

- Accident

- Measurement methodology and observation (Villeneuve d'Ascq)

Modeling crossing behaviour (1/4)

- Primary and secondary crossings



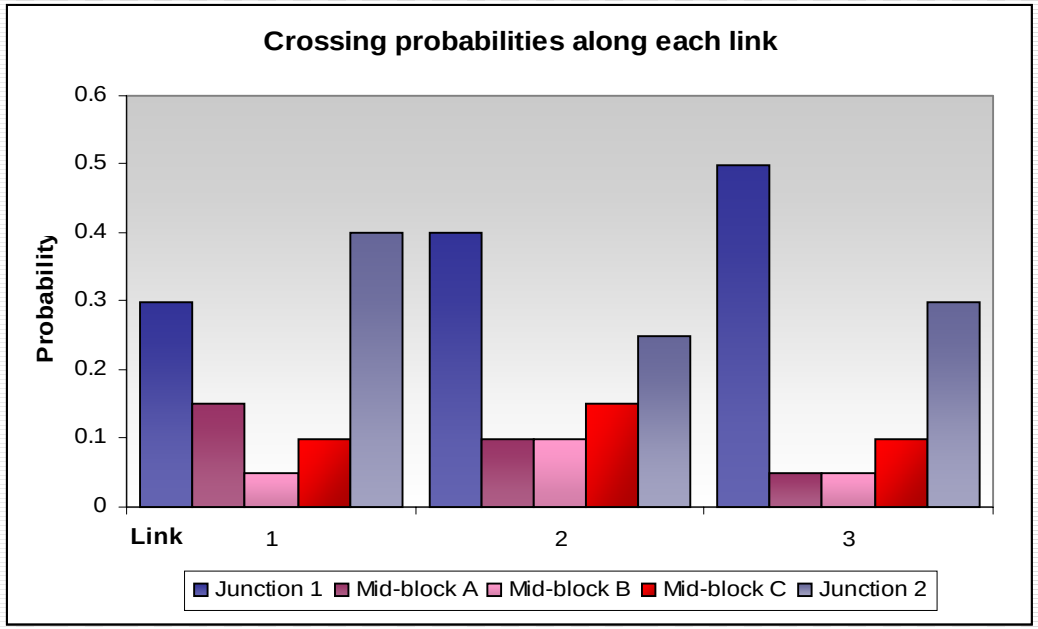
Along a sequence of links on the same direction

- Crossing probabilities only for primary crossings
- P=1 for secondary crossings

Choice of the place to cross (2/4)

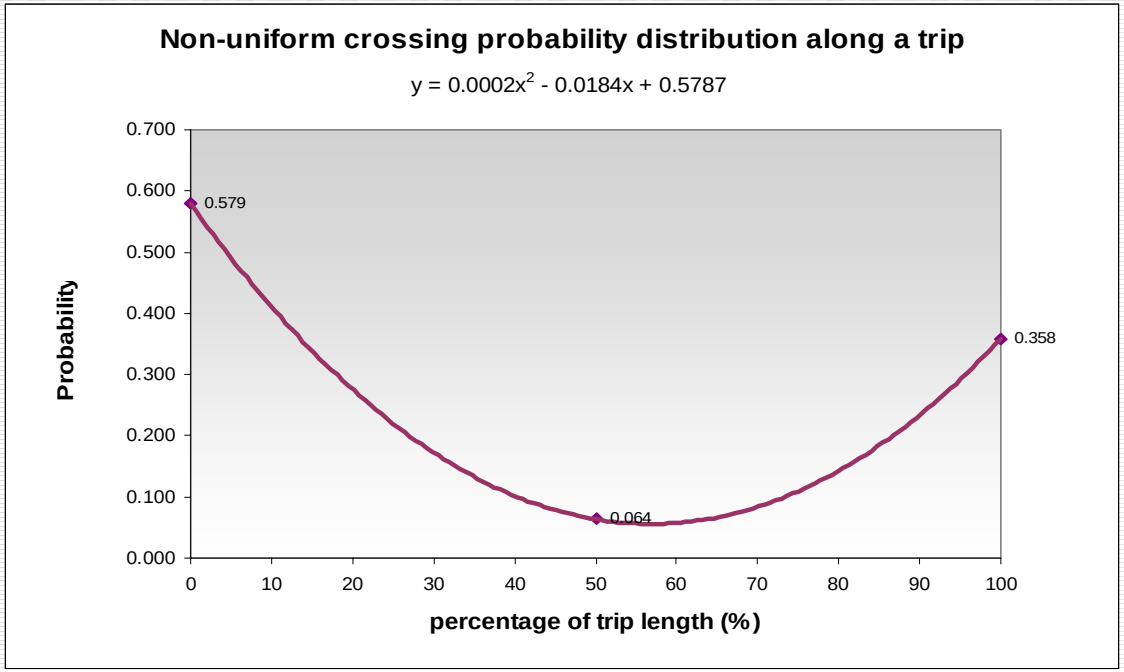
- A hierarchical model to estimate crossing probabilities along each link of a trip

- Level 1: Junction or mid-block (nested logit model)
- Level 2-1: Which junction (nested logit model)
- Level 2-2: Which interval at mid-block (level of service model)



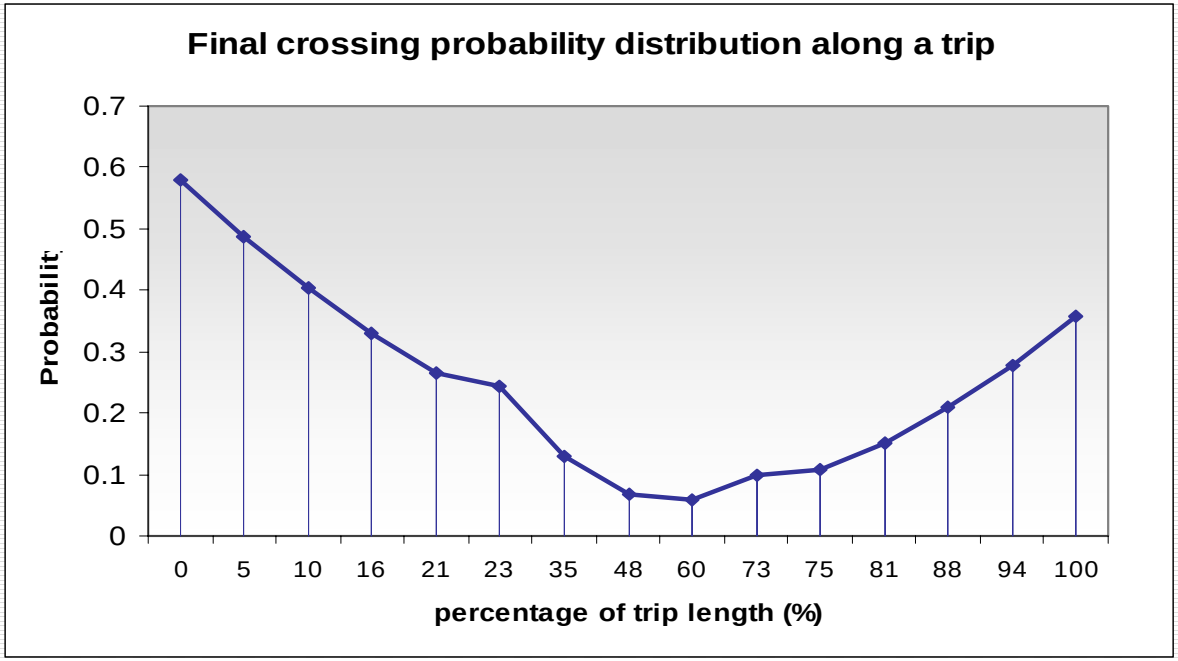
Preference beginning and end of the trip (3/4)

- Modeling the tendency to cross earlier or later along a trip (utility function of the nested logit model)



Combination (4/4)

- A final probability distribution along the trip



Synopsis

- An algorithm for the calculation of accident exposure along a trip in relation to crossing behavior and traffic parameters
- An algorithm for the estimation of type, number and location of crossings along a trip
- A complete and coherent approach to modeling crossing behavior and accident risk implemented in STEMS
- Preliminary results from model validation within the cities case-studies are promising
- Flexible (age) and further improvement possible