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## Algorithm of Signalized Crossroads Passage within the Range of Permissive-to-Restrictive Signals Exchange

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### Abstract

This article states the necessity to estimate vehicle deceleration rate using which the drivers shall reduce speed at a rate interpreted as "without recourse to emergency braking" rate. This article (i) presents definition of "emergency braking" term which is not set forth by applicable RF laws and regulations and (ii) defines vehicle deceleration rate using which the drivers shall reduce speed using technique hereinafter referred to as "without recourse to emergency braking". Algorithm of signalized crossroads passage within the range of permissive-to-restrictive signals exchange has been developed aiming to avoid miscarriage of justice during road accident (RA) investigation.

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*Keywords:* Signalized crossroads, traffic safety, emergency braking, set of traffic lights, traffic priority, vehicle stopping distance, vehicle deceleration rate, reducing speed at "without recourse to emergency braking" rate.

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### 1. Introduction

One of the most predominant reasons of road accidents occurring at signalized crossroads is vehicles exit from conflicting directions during permissive-to-restrictive signals exchange [Gorodokin and Almetova (2015)]. Basic task is to define priority among the road users. However, till now the current version of RF Traffic Rules does not allow to resolve the problem of priority to be realized by the driver passing the signalized crossroads upon permissive-to-

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restrictive signals exchange [Council of Ministers (2015)]. Failure to define priority results in wrong decisions regarding RA participant guiltiness. Aiming to solve this problem, the authors offer the algorithm allowing to define vehicle deceleration rate during permissive-to-restrictive signals exchange.

**Purpose:** definition of deceleration rate to be selected by the driver reducing the speed at "without recourse to emergency braking" rate. Deceleration rate obtained thereof may be used as technically substantiated value to solve the problem regarding determination of technical possibility to stop the vehicle in Traffic Rules prescribed point at the moment of amber light activation.

## 2. Main Text

Generally, priority for signalized crossroads pass is set forth by item 6.14 of the RF Traffic Rules. The current version of Traffic Rules reads as follows: "Drivers who are not capable to stop the vehicle without recourse to emergency braking (at the moment of (i) amber light coming on or (ii) lift of hand by traffic controller) in points defined by Traffic Rules item 6.13 are allowed to go on driving". Regretfully, the aforementioned wording not only makes solution of aforementioned problem difficult but, in most cases, excludes such correct solution [Gorodokin and Kudryavtseva (2015)]. At that, investigation of RA which occurred within signalized crossroads demands resolution of the issues regarding priority definition for RA-involved parties by the moment of reaching the collision point [Evtiukov and Vassiliev (2006)].

Analyzing the wording of Traffic Rules point 6.14 it is necessary to underline that term identified as "without recourse to emergency braking" is not specifically defined in RF Traffic Rules. Moreover, term "emergency braking" is not found there either.

"Emergency braking" is understood as braking performed by the driver via prompt transfer of foot onto the brake pedal followed by similarly prompt (with no change of foot motion rate) pedal depressing "as far as it can go" without controlling pedal compression force and dosage (for manually controlled vehicles, the meaning of depressing the brake lever by hand does not change). From the viewpoint of "driver's mastership", the aforementioned activities are not falling under the term identified as "efficient braking" since the latter implies proportional depressing of the brake pedal causing no wheels blocking.

Requirement identified as "without recourse to emergency braking" included in the USSR Traffic Rules (followed by inclusion of the same in the RF Traffic Rules) is and interpretation of Russian-language version of Convention on Road Signs and Signals, 1968 [Convention on Road Traffic (1971)]. In the USSR-ratified translation of the said Convention, the latter requirement's wording is given in Article III, it. 23 as follows: "iii) amber light which is activated alone or simultaneously with red light; being used alone, it means that neither vehicle may intersect the stopping line or drive beyond the traffic light with exception of cases where (at the moment of light coming on) the vehicle is so close to the line that cannot stop before the line (or traffic light) with account to traffic safety regulations requirements ...". The whole text contains discrepancies and technical errors like: "...light", "stopping line", "with account to traffic safety regulations requirements", "immediate exchange (of vehicle signal)" etc. Technically literate translation of the Convention text should read as follows: *"amber signal of the traffic control device may be activated alone or in conjunction with red signal; if only amber signal has been activated it means that vehicles are not allowed (i) to intersect the "stop-line" or (ii) advance beyond the traffic control device pillar with exception of cases where at the moment of signal coming on the vehicle was located at a distance (from "stop-line" or traffic control device pillar) which could not enable the vehicle to stop in safe manner..."*.

The key wording here is *"..... with exception of cases where at the moment of signal ("amber" color signal is meant) coming on the vehicle was located at a distance (from "stop-line" or traffic control device pillar) which could not enable the vehicle to stop in safe manner..."* In our case, the term "to stop in the safe manner" was converted (in the RF Traffic Rules) into the term "without recourse to emergency braking". Both aforementioned versions are allied from technical viewpoint because, in most cases, emergency braking may either (i) result in poor steer ability or (ii) cause surprise of other road users. Nevertheless, current version of Convention contains a term "stop in a safe manner" which can be (i) ambiguously construed and (ii) have different technical grounds. Namely absence of technically literate and grounded concepts ("stop in a safe manner" and "without recourse to emergency braking") caused necessity to give (to both terms) the technical rationale which may be appropriate in solving the issues associated with definition of priority for road users entering the road crossroads at the moment of traffic signals exchange [Kremenets

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