Challenges

Traffic control is a highly complex and difficult task. But what are the real challenges and obstacles which have to be treated with new and innovative control systems and which are explicitly addressed with ANDATA's traffic solutions?

Traffic is stochastic with lots of complex feedback and rebound effects

Good control of traffic needs mathematical models, which describe the behaviour of traffic participants and their vehicles as precisely as needed. Based on these models the relevant traffic measures (e.g. traffic lights) are controlled in a way that the traffic flow evolves in the best possible manner. For the pure description of inner flows this is already available in an acceptable quality. What is still hard to tackle are the boundary conditions like the inflows and realistic turn rates.

For example if one improves the flow capacities of a junction this does not automatically resolve congestion, because the improved flow may induce increasing inflow. Traffic is full of such **feedback effects with lots of known and unknown dependencies and correlations**, which are really hard to identify and quantify. Additionally these are very volatile. Traffic participants are humans and act as such, i.e. by anticipating and quickly adapting to changes in the traffic situations. But they do this differently in different situations, times, locations, and local conditions.

"Intelligent" traffic control has to deal with the **volatility of the boundary conditions** and has itself to predict the **anticipation of the traffic participants**. However, if these dependencies and relations cannot always be predicted, one must at least be able to **adapt quickly** and update control accordingly.

Unknown effectiveness of actions and measures

For "hard" traffic lights the behaviour of the traffic participants can be estimated precisely (normally they stop at a red light). But the reaction to weak measures like information systems and rerouting recommendations cannot be predicted so well. The number of traffic participants i.e. following a park & ride recommendation depends on the traffic participant himself and his or her subjective perception of the traffic situation, the usability and information design of the recommendation, economic aspects, and several other weak factors. "Intelligent" traffic control at least needs some rough estimates concerning these relations so as to be able to achieve optimum control. Here the same rule applies: **if not all effects**

of the relevant traffic measures can be predicted, one must at least be able to adapt quickly.

Conflicting requirements and lack of transparency in the quantitative effects

Even if a precise mathematical model were available for traffic planning and control, the question of the right formulation of the control targets would still remain. One of the main difficulties in traffic control and management are the **intrinsically conflicting requirements with a contradictory structure**. The target criteria are often in conflict with each other, and their quantitative relations and dependencies are not available or are not obvious to the decision maker. The story is seldom about optimization but most of the time about balancing compromises and identifying and managing conflicts in requirements. This needs the proper identification and illustration of the quantitative relations and dependencies between the various target criteria accompanied by appropriate methods and procedures for the management of the functional requirements.

Algorithms, software and electronics determine functionality and performance

Traffic engineering, like in many other saturated fields of application, is in the situation that major improvements primarily rely on software and no longer on hardware. The fulfilment of requirements for the desired functionality can only be realized by the extensive utilization and integration of solutions from electronics and information technologies. **The main functionality in traffic control will be determined by the applied software and control algorithms**. In the same way that mechanical engineering is nowadays already dominated by mechatronics, traffic technology will also be dominated by “infratronics” in the future.

Data and models are key factors for success

The key in the identification and quantification of the complex relations and dependencies in traffic lie in the data from real measurements and simulations. High quality traffic data is already increasingly available for real time acquisition of the traffic situations. But it is not enough merely to display the traffic data in various formats and media to the traffic participants and to delegate the intelligence back to the traffic users. Instead, “intelligent” traffic control requires the **steady analysis of the data with the relevant data mining strategies to turn the data into up-to-date models for decision support** and prediction. **Predictive control strategies** can only be implemented sustainably if the control models can keep pace with the quick changes in the traffic system.

Innovations by open systems

Many innovations are only possible by the break-up of proprietary, closed systems and the introduction of open and manufacturer-independent solutions. **The separation of hardware and software is normally followed by a considerable reduction in development and implementation efforts**. On the other hand these need competence in system specification, system integration and system rating with the installation of appropriate integration procedures.

Integration and holistic system development instead of reductionism

For such complex systems like "intelligent" traffic control it is not expected that single break- through innovations will solve the overall problem. This is especially true for single components. Instead the story will be about the **coordinated combination and neat integration of several single particular innovative solutions into a well-functioning overall system**. This requires systematic **top-down**-procedures **instead of** reductionist **bottom-up** procedures.

Background

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function gmap3_allow() { document.cookie = 'dlh_googlemaps=ok; max-age=31536000 ; path=/'; var mapsSrc = document.createElement('script'); mapsSrc.type = 'text/javascript'; mapsSrc.src = 'https://maps.googleapis.com/maps/api/js?key=AIzaSyATmo_65LEnkNZxmaIGh23OBx9Vq-3c7Ow&language=en'; document.getElementsByTagName('head')[0].appendChild(mapsSrc); window.setTimeout("gmap3_initialize()", 500); } function gmap3_initialize() { if(!window.google){ return false; } var gmap3_Options = { zoom: 6 , center: new google.maps.LatLng(47.94515,14.767537) , mapTypeId: google.maps.MapTypeId.ROADMAP , draggable: true , disableDoubleClickZoom: true , scrollwheel: true , mapTypeControl: false , overviewMapControl: false , streetViewControl: false , rotateControl: false , panControl: false , zoomControl: false , scaleControl: false }; google.maps.event.addDomListener(window, 'resize', function() { var center = gmap3.getCenter(); google.maps.event.trigger(gmap3, 'resize'); gmap3.setCenter(center); }); var gmap3 = new google.maps.Map(document.getElementById("dlh_googlemap_3"), gmap3_Options); var gmap3_markers = []; var gmap3_0_marker = new google.maps.Marker({ position: new google.maps.LatLng(47.677272,13.095503) , map: gmap3 , title:"ANDATA Hallein" , zIndex: 1 }); if(typeof gmap3_markers === 'undefined'){ var gmap3_markers = []; } gmap3_markers.push(gmap3_0_marker); var gmap3_0_infowindow = new google.maps.InfoWindow({ position: new google.maps.LatLng(47.677272,13.095503), content: '

Routing from your Address:

' }); google.maps.event.addListener(gmap3_0_marker, 'click', function() {

gmap3_0_infowindow.open(gmap3); }); var gmap3_1_marker = new google.maps.Marker({ position: new google.maps.LatLng(48.191839,16.361467) , map: gmap3 , title:"ANDATA Wien" , zIndex: 1 }); if(typeof gmap3_markers === 'undefined'){ var gmap3_markers = []; } gmap3_markers.push(gmap3_1_marker); var gmap3_1_infowindow = new google.maps.InfoWindow({ position: new google.maps.LatLng(48.191839,16.361467), content: '

Routing from your Address:

' }); google.maps.event.addListener(gmap3_1_marker, 'click', function() { gmap3_1_infowindow.open(gmap3); }); if(window.gmap3_dynmap){ gmap3_dynmap(gmap3); } } if(window.addEvent) { window.addEvent('domready', function() { gmap3_initialize(); }); } else if(typeof jQuery == "function") { jQuery(document).ready(function(){ gmap3_initialize(); }); } else { window.setTimeout("gmap3_initialize()", 500); }