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Identification and prediction of maritime ferry operation process related to operating environment threats and extreme weather hazards

Keywords

climate-weather change process, identification, prediction, operating environment threats, maritime ferry

Abstract

The paper is concerned with an application of the critical infrastructure operation process including operating environment threats and extreme weather hazards model to identification and prediction of this process for the maritime ferry. There are distinguished four processes for the considered maritime ferry operating area. Further, using identified parameters of the operation process including operating environment threats and the climate-weather change processes for the maritime ferry operating area, there are determined the unknown parameters of these processes. Namely, the probabilities of the ferry processes staying at the initial states, the probabilities of the ferry processes transitions between the states and the mean values of the ferry processes conditional sojourn times at particular states. Finally, there are predicted the main characteristics of the maritime ferry operation process including operating environment threats and extreme weather hazards at the distinguished operating area.

1. Introduction

The maritime ferry operation process including operating environment threats is described in [2]. The climate-weather change process for the maritime ferry operating area is modelled in [1], [3], [7]. In this paper, the identification of the ferry operation process including operating environment threats and extreme weather hazards is performed. To do this, we can use the evaluated parameters of the ferry operation process including operating environment threats from [2] and parameters of the climate-weather change process at its operating area from [7]. This way, having this processes identified, the prediction of the maritime ferry operation process including operating environment threats and extreme weathers hazards characteristics is performed.

2. Maritime ferry operation process including operating environment threats related to climate-weather change identification

Assuming that the maritime ferry operation process including operating environment threats and the climate-weather change processes at its operating area are independent, to identify the unknown parameters of the maritime ferry operation process including operating environment threats related to climate-weather change processes only the suitable statistical data coming from real realizations of the maritime ferry operation process including operating environment threats and of the maritime ferry climate-weather change processes should be collected. The statistical identification of the maritime ferry operation process including operating environment threats related to climate-weather change was performed: the operation states were distinguished and the vector of probabilities of the maritime ferry operation process including operating environment threats related to climate-weather change staying at the initial operation states were evaluated.

2.1. States of maritime ferry operation process including operating environment threats related to climate-weather change

Maritime ferry operation process related to climate-weather change process for maritime ferry Gdynia port operating area - data coming from first measurement point

The maritime ferry operation process including operating environment threats related to climate-

weather change process $Z'C^1(t),\ t \in <0,+\infty)$, can take $v'w^1 = 72 \cdot 6 = 432$ different operation states $z'c_{1\ 1}$, $z'c_{1\ 2}$, …, $z'c_{72\ 6}$;

Maritime ferry operation process related to climate-weather change process for maritime ferry restricted waters operating area - data coming from second measurement point

The maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^2(t),\ t \in <0,+\infty)$, can take $v'w^2 = 72 \cdot 6 = 432$ different operation states $z'c_{1\ 1}$, $z'c_{1\ 2}$, …, $z'c_{72\ 6}$;

Maritime ferry operation process related to climate-weather change process for maritime ferry Baltic Sea open waters operating area - data coming from 1353, 1389, 1422 and 1458 measurement points

The maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^3(t),\ t \in <0,+\infty)$, can take $v'w^3 = 72 \cdot 6 = 432$ different operation states $z'c_{1\ 1}$, $z'c_{1\ 2}$, …, $z'c_{72\ 6}$.

Maritime ferry operation process related to climate-weather change process for maritime ferry Karlskrona port operating area - data coming from last measurement point

The maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^4(t),\ t \in <0,+\infty)$, can take $v'w^4 = 72 \cdot 6 = 432$ different operation states $z'c_{1\ 1}$, $z'c_{1\ 2}$, …, $z'c_{72\ 6}$.

2.2. Parameters of maritime ferry operation process related to climate-weather change

Maritime ferry operation process related to climate-weather change process for maritime ferry Gdynia port operating area - data coming from first measurement point

After assuming that the maritime ferry operation process including operating environment threats and the climate-weather change process at its operating area are independent, it is possible to evaluate the following unknown basic parameter of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^1(t)$ [4]:

- the vector

$$[p'q_{ij}(0)]_{1x432} = [0.4332771, 0.0281097, 0.4109832, 0.0174474, 0.0794826, 0, 0.007599, 0.000493, 0.007208, 0.000306, 0.001394, 0, 0, 0, 0, 0, 0, 0.0061239, 0.0003973, 0.0058088, 0.0002466, 0.0011234, 0, ..., 0] \quad (1)$$

of initial probabilities of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^1(t)$ staying at the initial moment $t = 0$ at the operation states $z'c_{ij}$, $i = 1,2,\ldots,72$, $j = 1,2,\ldots,6$;
- the matrix $[p'q_{ij\ kl}]_{432x432}$ of the probabilities $p'q_{ij\ kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, of transitions of the maritime ferry operation process related to climate-weather change process $Z'C^1(t)$ from the operation state $z'c_{ij}$ into the operation state $z'c_{kl}$ could be found in [4];
- the matrix $[N'_{ij\ kl}(t)]_{432\times432}$ of the mean values of the maritime ferry operation process related to climate-weather change process $Z'C^1(t)$ conditional sojourn times $\theta' C^1_{ij\ kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, at the operation state $z'c_{ij}$, when the next operation state is $z'c_{kl}$ could be found in [4].

Maritime ferry operation process related to climate-weather change process for maritime ferry restricted waters operating area - data coming from second measurement point

After assuming that the maritime ferry operation process including operating environment threats and the climate-weather change process at its operating area are independent, it is possible to evaluate the following unknown basic parameters of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^2(t)$ [4]:
- the vector

$$[p'q_{ij}(0)]_{1x432} = [0.649431, 0.2626803, 0.0058158, 0, 0.0232632, 0.0281097, 0.01139, 0.004607, 0.000102, 0, 0.000408, 0.000493, 0, 0, 0, 0, 0, 0.009179, 0.0037127, 0.0000822, 0, 0.0003288, 0.0003973, 0, ..., 0] \quad (2)$$

of initial probabilities of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^2(t)$ staying at the initial moment $t = 0$ at the operation states $z'c_{ij}$, $i = 1,2,\ldots,72$, $j = 1,2,\ldots,6$;
- the matrix $[p'q_{ij\ kl}]_{432x432}$, of the probabilities $p'q_{ij\ kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, of transitions of the

maritime ferry operation process related to climate-weather change process $Z'C^2(t)$ from the operation state $z'c_{ij}$ into the operation state $z'c_{kl}$ could be found in [4];
- the matrix $[N'_{ij\,kl}(t)]_{432\times432}$ of the mean values of the maritime ferry operation process related to climate-weather change process $Z'C^2(t)$ conditional sojourn times $\theta' C^2_{ij\,kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, at the operation state $z'c_{ij}$, when the next operation state is $z'c_{kl}$ could be found in [4].

Maritime ferry operation process related to climate-weather change process for maritime ferry Baltic Sea open waters operating area - data coming from 1353, 1389, 1422 and 1458 measurement points

After assuming that the maritime ferry operation process including operating environment threats and the climate-weather change process at its operating area are independent, it is possible to evaluate the following unknown basic parameters of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^3(t)$ [4]:
- the vector

$$[p'\,q_{ij}(0)]_{1x432} = [0.5767335, 0.3382857, 0, 0, 0.038772, 0.0155088, 0.010115, 0.005933, 0, 0, 0.00068, 0.000272, 0, 0, 0, 0, 0, 0, 0.0081515, 0.0047813, 0, 0, 0.000548, 0.0002192, 0, ..., 0] \quad (3)$$

of initial probabilities of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^3(t)$ staying at the initial moment $t = 0$ at the operation states $z'c_{ij}$, $i = 1,2,\ldots,72$, $j = 1,2,\ldots,6$;
- the matrix $[p'\,q_{ij\,kl}]_{432x432}$ of the probabilities $p'q_{ij\,kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, of transitions of the maritime ferry operation process related to climate-weather change process $Z'C^3(t)$ from the operation state $z'c_{ij}$ into the the operation state $z'c_{kl}$ can be found in [4];
- the matrix $[N'_{ij\,kl}(t)]_{432\times432}$ of the mean values of the maritime ferry operation process related to climate-weather change process $Z'C^3(t)$ conditional sojourn times $\theta' C^3_{ij\,kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, at the operation state $z'c_{ij}$, when the next operation state is $z'c_{kl}$ can be found in [4].

Maritime ferry operation process related to climate-weather change process for maritime ferry Karlskrona port operating area - data coming from last measurement point

After assuming that the maritime ferry operation process including operating environment threats and the climate-weather change process at its operating area are independent, it is possible to evaluate the following unknown basic parameter of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^4(t)$ [4]:
- the vector

$$[p'\,q_{ij}(0)]_{1x432} = [0.3140532, 0.0174474, 0.4332771, 0.0281097, 0.1764126, 0, 0.005508, 0.000306, 0.007599, 0.000493, 0.003094, 0, 0, 0, 0, 0, 0, 0.0044388, 0.0002466, 0.0061239, 0.0003973, 0.0024934, 0, ..., 0] \quad (4)$$

of initial probabilities of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^4(t)$ staying at the initial moment $t = 0$ at the operation states $z'c_{ij}$, $i = 1,2,\ldots,72$, $j = 1,2,\ldots,6$;
- the matrix $[p'\,q_{ij\,kl}]_{432x432}$ of the probabilities $p'q_{ij\,kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, of transitions of the maritime ferry operation process related to climate-weather change process $Z'C^4(t)$ from the operation state $z'c_{ij}$ into the the operation state $z'c_{kl}$ could be found in [4];
- the matrix $[N'_{ij\,kl}(t)]_{432\times432}$ of the mean values of the maritime ferry operation process related to climate-weather change process $Z'C^4(t)$ conditional sojourn times $\theta' C^4_{ij\,kl}$, $i, k = 1,2,\ldots,72$, $j, l = 1,2,\ldots,6$, at the operation state $z'c_{ij}$, when the next operation state is $z'c_{kl}$ could be found in [4].

3. Maritime ferry operation process including operating environment threats related to climate-weather change prediction characteristics

The maritime ferry operation process including operating environment threats related to climate-weather change is defined in [5]. Considering these results and assuming that we have identified the unknown parameters of the maritime ferry operation process including operating environment threats related to climate-weather change, we can predict basic characteristics of this process.

3.1. Transient probabilities of maritime ferry operation process including operating environment threats related to climate-weather change

Maritime ferry operation process related to climate-weather change process for maritime ferry Gdynia

port operating area - data coming from first measurement point

The limit values of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^1(t)$ transient probabilities $p'q_{ij}$, i = 1,2,…,72, j =1,2,…,6, at the particular operation states $z'c_{ij}$, are given in the vector [4]:

$[p'\ q_{ij}]_{1x432} \cong$ [0.014948, 0.000407, 0.016687, 0.00037, 0.004588, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.000404, 0.000011, 0.000451, 0.00001, 0.000124, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.0101, 0.000275, 0.011275, 0.00025, 0.0031, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.01414, 0.000385, 0.015785, 0.00035, 0.00434, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.146248, 0.003982, 0.163262, 0.00362, 0.044888, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.0101, 0.000275, 0.011275, 0.00025, 0.0031, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.000808, 0.000022, 0.000902, 0.00002, 0.000248, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.00606, 0.000165, 0.006765, 0.00015, 0.00186, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.014544, 0.000396, 0.016236, 0.00036, 0.004464, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.000404, 0.000011, 0.000451, 0.00001, 0.000124, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.000808, 0.000022, 0.000902, 0.00002, 0.000248, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.00606, 0.000165, 0.006765, 0.00015, 0.00186, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.1414, 0.00385, 0.15785, 0.0035, 0.0434, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.013332, 0.000363, 0.014883, 0.00033, 0.004092, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.009292, 0.000253, 0.010373, 0.00023, 0.002852, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.000808, 0.000022, 0.000902, 0.00002, 0.000248, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.001616, 0.000044, 0.001804, 0.00004, 0.000496, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0, 0.004848, 0.000132, 0.005412, 0.00012, 0.001488, 0, 0.0002424, 0.0000066, 0.0002706, 0.000006, 0.0000744, 0, 0, 0, 0, 0, 0, 0, 0.0001616, 0.0000044, 0.0001804, 0.000004, 0.0000496, 0]; (5)

Maritime ferry operation process related to climate-weather change process for maritime ferry restricted waters operating area - data coming from second measurement point

The limit values of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^2(t)$ transient probabilities $p'q_{ij}$, i = 1,2,…,72, j =1,2,…,6, at the particular operation states $z'c_{ij}$, are given in the vector:

$[p'\ q_{ij}]_{1x432} \cong$ [0.029785, 0.006179, 0.000296, 0, 0.000259, 0.000481, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.000805, 0.000167, 0.000008, 0, 0.000007, 0.000013, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.020125, 0.004175, 0.0002, 0, 0.000175, 0.000325, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.028175, 0.005845, 0.00028, 0, 0.000245, 0.000455, 0.000483,

0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.29141, 0.060454, 0.002896, 0, 0.002534, 0.004706, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.020125, 0.004175, 0.0002, 0, 0.000175, 0.000325, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.00161, 0.000334, 0.000016, 0, 0.000014, 0.000026, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.012075, 0.002505, 0.00012, 0, 0.000105, 0.000195, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.02898, 0.006012, 0.000288, 0, 0.000252, 0.000468, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.000805, 0.000167, 0.000008, 0, 0.000007, 0.000013, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.00161, 0.000334, 0.000016, 0, 0.000014, 0.000026, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.012075, 0.002505, 0.00012, 0, 0.000105, 0.000195, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.28175, 0.05845, 0.0028, 0, 0.00245, 0.00455, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.026565, 0.005511, 0.000264, 0, 0.000231, 0.000429, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.018515, 0.003841, 0.000184, 0, 0.000161, 0.000299, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.00161, 0.000334, 0.000016, 0, 0.000014, 0.000026, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.00322, 0.000668, 0.000032, 0, 0.000028, 0.000052, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028, 0.0000052, 0.00966, 0.002004, 0.000096, 0, 0.000084, 0.000156, 0.000483, 0.0001002, 0.0000048, 0, 0.0000042, 0.0000078, 0, 0, 0, 0, 0, 0, 0.000322, 0.0000668, 0.0000032, 0, 0.0000028,0.0000052]; (6)

Maritime ferry operation process related to climate-weather change process for maritime ferry Baltic Sea open waters operating area - data coming from 1353, 1389, 1422 and 1458 measurement points

The limit values of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^3(t)$ transient probabilities $p'q_{ij}$, $i = 1,2,\ldots,72$, $j = 1,2,\ldots,6$, at the particular operation states $z'c_{ij}$, are given in the vector [4]:

$[p'q_{ij}]_{1x432} \cong$ [0.029304, 0.006845, 0, 0, 0.000592, 0.000259, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.000792, 0.000185, 0, 0, 0.000016, 0.000007, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.0198, 0.004625, 0, 0, 0.0004, 0.000175, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.02772, 0.006475, 0, 0, 0.00056, 0.000245, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.286704, 0.06697, 0, 0, 0.005792, 0.002534, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.0198, 0.004625, 0, 0, 0.0004, 0.000175, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.001584, 0.00037, 0, 0, 0.000032, 0.000014, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.01188, 0.002775, 0, 0, 0.00024, 0.000105, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.028512, 0.00666, 0, 0, 0.000576, 0.000252, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.000792, 0.000185, 0, 0, 0.000016, 0.000007, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.001584, 0.00037, 0, 0, 0.000032, 0.000014, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.01188, 0.002775, 0, 0, 0.00024, 0.000105, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064,

0.0000028, 0.2772, 0.06475, 0, 0, 0.0056, 0.00245, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.026136, 0.006105, 0, 0, 0.000528, 0.000231, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.018216, 0.004255, 0, 0, 0.000368, 0.000161, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.001584, 0.00037, 0, 0, 0.000032, 0.000014, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.003168, 0.00074, 0, 0, 0.000064, 0.000028, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028, 0.009504, 0.00222, 0, 0, 0.000192, 0.000084, 0.0004752, 0.000111, 0, 0, 0.0000096, 0.0000042, 0, 0, 0, 0, 0, 0, 0.0003168, 0.000074, 0, 0, 0.0000064, 0.0000028]. (7)

Maritime ferry operation process related to climate-weather change process for maritime ferry Karlskrona port operating area - data coming from last measurement point

The limit values of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^4(t)$ transient probabilities $p'q_{ij}$, $i = 1,2,\ldots,72$, $j = 1,2,\ldots,6$, at the particular operation states $z'c_{ij}$, are given in the vector [4]:

$[p' q_{ij}]_{1x432} \cong$ [0.014578, 0.000592, 0.011507, 0.00111, 0.009213, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.000394, 0.000016, 0.000311, 0.00003, 0.000249, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.00985, 0.0004, 0.007775, 0.00075, 0.006225, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.01379, 0.00056, 0.010885, 0.00105, 0.008715, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.142628, 0.005792, 0.112582, 0.01086, 0.090138, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.00985, 0.0004, 0.007775, 0.00075, 0.006225, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.000788, 0.000032, 0.000622, 0.00006, 0.000498, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.00591, 0.00024, 0.004665, 0.00045, 0.003735, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.014184, 0.000576, 0.011196, 0.00108, 0.008964, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.000394, 0.000016, 0.000311, 0.00003, 0.000249, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.000788, 0.000032, 0.000622, 0.00006, 0.000498, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.00591, 0.00024, 0.004665, 0.00045, 0.003735, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.1379, 0.0056, 0.10885, 0.0105, 0.08715, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.013002, 0.000528, 0.010263, 0.00099, 0.008217, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.009062, 0.000368, 0.007153, 0.00069, 0.005727, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.000788, 0.000032, 0.000622, 0.00006, 0.000498, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.001576, 0.000064, 0.001244, 0.00012, 0.000996, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0, 0.004728, 0.000192, 0.003732, 0.00036, 0.002988, 0, 0.0002364, 0.0000096, 0.0001866, 0.000018, 0.0001494, 0, 0, 0, 0, 0, 0, 0, 0.0001576, 0.0000064, 0.0001244, 0.000012, 0.0000996, 0]. (8)

3.2. Total sojourn times of maritime ferry operation process including operating environment threats related to climate-weather change

Maritime ferry operation process related to climate-weather change process for maritime ferry Gdynia port operating area - data coming from first measurement point

The expected values of the total sojourn times $\theta' C_{ij}^{1}$, i = 1,2,…,72, j =1,2,…,6, of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^{1}(t)$ at the particular operation states $z'c_{ij}$, during the fixed operation time $Z'C^{1}$ = 1 month (February) = 29 days, are given in the vector (its coordinates are measured in days) [4]:

$[\hat{M}' \hat{N}_{ij}^{1}]_{1x432} = [E[\theta' C_{ij}^{1}]]_{1x432} \cong$ [0.433492, 0.011803, 0.483923, 0.01073, 0.133052, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.011716, 0.000319, 0.013079, 0.00029, 0.003596, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.2929, 0.007975, 0.326975, 0.00725, 0.0899, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.41006, 0.011165, 0.457765, 0.01015, 0.12586, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 4.241192, 0.115478, 4.734598, 0.10498, 1.301752, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.2929, 0.007975, 0.326975, 0.00725, 0.0899, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.023432, 0.000638, 0.026158, 0.00058, 0.007192, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.17574, 0.004785, 0.196185, 0.00435, 0.05394, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.421776, 0.011484, 0.470844, 0.01044, 0.129456, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.011716, 0.000319, 0.013079, 0.00029, 0.003596, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.023432, 0.000638, 0.026158, 0.00058, 0.007192, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.17574, 0.004785, 0.196185, 0.00435, 0.05394, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 4.1006, 0.11165, 4.57765, 0.1015, 1.2586, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.386628, 0.010527, 0.431607, 0.00957, 0.118668, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.269468, 0.007337, 0.300817, 0.00667, 0.082708, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.023432, 0.000638, 0.026158, 0.00058, 0.007192, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.046864, 0.001276, 0.052316, 0.00116, 0.014384, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0, 0.140592, 0.003828, 0.156948, 0.00348, 0.043152, 0, 0.0070296, 0.0001914, 0.0078474, 0.000174, 0.0021576, 0, 0, 0, 0, 0, 0, 0, 0.0046864, 0.0001276, 0.0052316, 0.000116, 0.0014384, 0]. (9)

Maritime ferry operation process related to climate-weather change process for maritime ferry restricted waters operating area - data coming from second measurement point

The expected values of the total sojourn times $\theta' C_{ij}^{2}$, i = 1,2,…,72, j =1,2,…,6, of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^{2}(t)$ at the particular operation states $z'c_{ij}$, during the fixed operation time $Z'C^{2}$ = 1 month (February) = 29 days, are given in the vector (its coordinates are measured in days) [4]:

$[\hat{M}'\,\hat{N}_{ij}^{2}]_{1x432} = [E[\theta'\,C_{ij}^{2}]]_{1x432} \cong$ [0.863765, 0.179191, 0.008584, 0, 0.007511, 0.013949, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.023345, 0.004843, 0.000232, 0, 0.000203, 0.000377, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.583625, 0.121075, 0.0058, 0, 0.005075, 0.009425, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.817075, 0.169505, 0.00812, 0, 0.007105, 0.013195, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 8.45089, 1.753166, 0.083984, 0, 0.073486, 0.136474, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.583625, 0.121075, 0.0058, 0, 0.005075, 0.009425, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.04669, 0.009686, 0.000464, 0, 0.000406, 0.000754, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.350175, 0.072645, 0.00348, 0, 0.003045, 0.005655, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.84042, 0.174348, 0.008352, 0, 0.007308, 0.013572, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.023345, 0.004843, 0.000232, 0, 0.000203, 0.000377, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.04669, 0.009686, 0.000464, 0, 0.000406, 0.000754, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.350175, 0.072645, 0.00348, 0, 0.003045, 0.005655, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 8.17075, 1.69505, 0.0812, 0, 0.07105, 0.13195, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.770385, 0.159819, 0.007656, 0, 0.006699, 0.012441, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.536935, 0.111389, 0.005336, 0, 0.004669, 0.008671, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.04669, 0.009686, 0.000464, 0, 0.000406, 0.000754, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.09338, 0.019372, 0.000928, 0, 0.000812, 0.001508, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508, 0.28014, 0.058116, 0.002784, 0, 0.002436, 0.004524, 0.014007, 0.0029058, 0.0001392, 0, 0.0001218, 0.0002262, 0, 0, 0, 0, 0, 0, 0.009338, 0.0019372, 0.0000928, 0, 0.0000812, 0.0001508]; (10)

<u>Maritime ferry operation process related to climate-weather change process for maritime ferry Baltic Sea open waters operating area - data coming from 1353, 1389, 1422 and 1458 measurement points</u>

The expected values of the total sojourn times $\theta'\,C_{ij}^{3}$, i = 1,2,…,72, j =1,2,…,6, of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^{3}(t)$ at the particular operation states $z'c_{ij}$, during the fixed operation time $Z'C^{3}$ = 1 month (February) = 29 days, are given in the vector (its coordinates are measured in days) [4]:

$[\hat{M}'\,\hat{N}_{ij}^{3}]_{1x432} = [E[\theta'\,C_{ij}^{3}]]_{1x432} \cong$ [0.849816, 0.198505, 0, 0, 0.017168, 0.007511, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.022968, 0.005365, 0, 0, 0.000464, 0.000203, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.5742, 0.134125, 0, 0, 0.0116, 0.005075, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.80388, 0.187775, 0, 0, 0.01624, 0.007105, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 8.314416, 1.94213, 0, 0, 0.167968, 0.073486, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.5742, 0.134125, 0, 0, 0.0116, 0.005075, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146,

0, 0, 0.0001856, 0.0000812, 0.045936, 0.01073, 0, 0, 0.000928, 0.000406, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.34452, 0.080475, 0, 0, 0.00696, 0.003045, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.826848, 0.19314, 0, 0, 0.016704, 0.007308, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.022968, 0.005365, 0, 0, 0.000464, 0.000203, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.045936, 0.01073, 0, 0, 0.000928, 0.000406, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.34452, 0.080475, 0, 0, 0.00696, 0.003045, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 8.0388, 1.87775, 0, 0, 0.1624, 0.07105, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.757944, 0.177045, 0, 0, 0.015312, 0.006699, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.528264, 0.123395, 0, 0, 0.010672, 0.004669, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.045936, 0.01073, 0, 0, 0.000928, 0.000406, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.091872, 0.02146, 0, 0, 0.001856, 0.000812, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812, 0.275616, 0.06438, 0, 0, 0.005568, 0.002436, 0.0137808, 0.003219, 0, 0, 0.0002784, 0.0001218, 0, 0, 0, 0, 0, 0, 0.0091872, 0.002146, 0, 0, 0.0001856, 0.0000812]. (11)

Maritime ferry operation process related to climate-weather change process for maritime ferry Karlskrona port operating area - data coming from last measurement point

The expected values of the total sojourn times $\theta' C_{ij}^4$, i = 1,2,…,72, j =1,2,…,6, of the maritime ferry operation process including operating environment threats related to climate-weather change process $Z'C^4(t)$ at the particular operation states $z'c_{ij}$, during the fixed operation time $Z'C^4$ = 1 month (February) = 29 days, are given in the vector (its coordinates are measured in days) [4]:

$$[\hat{M}'\,\hat{N}_{ij}^4]_{1x432} = [E[\theta' C_{ij}^4]]_{1x432} \cong [0.422762,$$
0.017168, 0.333703, 0.03219, 0.267177, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.011426, 0.000464, 0.009019, 0.00087, 0.007221, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.28565, 0.0116, 0.225475, 0.02175, 0.180525, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.39991, 0.01624, 0.315665, 0.03045, 0.252735, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 4.136212, 0.167968, 3.264878, 0.31494, 2.614002, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.28565, 0.0116, 0.225475, 0.02175, 0.180525, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.022852, 0.000928, 0.018038, 0.00174, 0.014442, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.17139, 0.00696, 0.135285, 0.01305, 0.108315, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.411336, 0.016704, 0.324684, 0.03132, 0.259956, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.011426, 0.000464, 0.009019, 0.00087, 0.007221, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.022852, 0.000928, 0.018038, 0.00174, 0.014442, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.17139, 0.00696, 0.135285, 0.01305, 0.108315, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 3.9991, 0.1624, 3.15665, 0.3045, 2.52735, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348,

0.0028884, 0, 0.377058, 0.015312, 0.297627, 0.02871, 0.238293, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.262798, 0.010672, 0.207437, 0.02001, 0.166083, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.022852, 0.000928, 0.018038, 0.00174, 0.014442, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.045704, 0.001856, 0.036076, 0.00348, 0.028884, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0, 0.137112, 0.005568, 0.108228, 0.01044, 0.086652, 0, 0.0068556, 0.0002784, 0.0054114, 0.000522, 0.0043326, 0, 0, 0, 0, 0, 0, 0, 0.0045704, 0.0001856, 0.0036076, 0.000348, 0.0028884, 0]. (12)

4. Conclusions

The probabilistic model of the critical infrastructure operation process including operating environment threats and extreme weather hazards presented in [6] was applied to identification and prediction of this process for the considered maritime ferry. The obtained results justify very high importance of considering the operation process related to climate-weather change. Especially, this considering is important in the investigation of the operation process including operating environment threats related to climate weather change influence on the critical infrastructure safety as it could be different at various operating states and at the various operating areas [5].

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